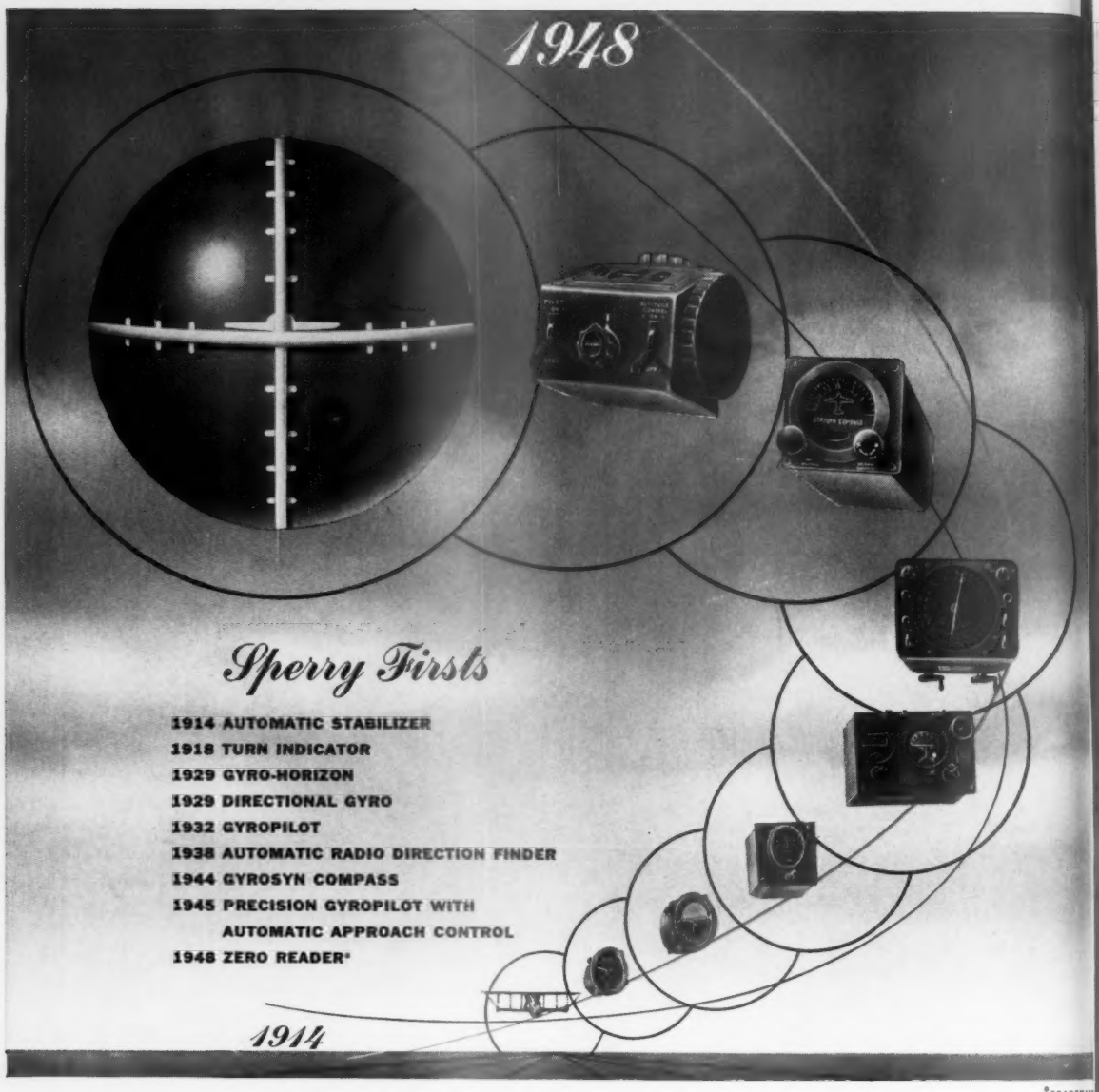
AERONAUTICAL ENGINEERING REVIEW

INSTITUTE OF THE AERONAUTICAL SCIENCES

JULY 1949



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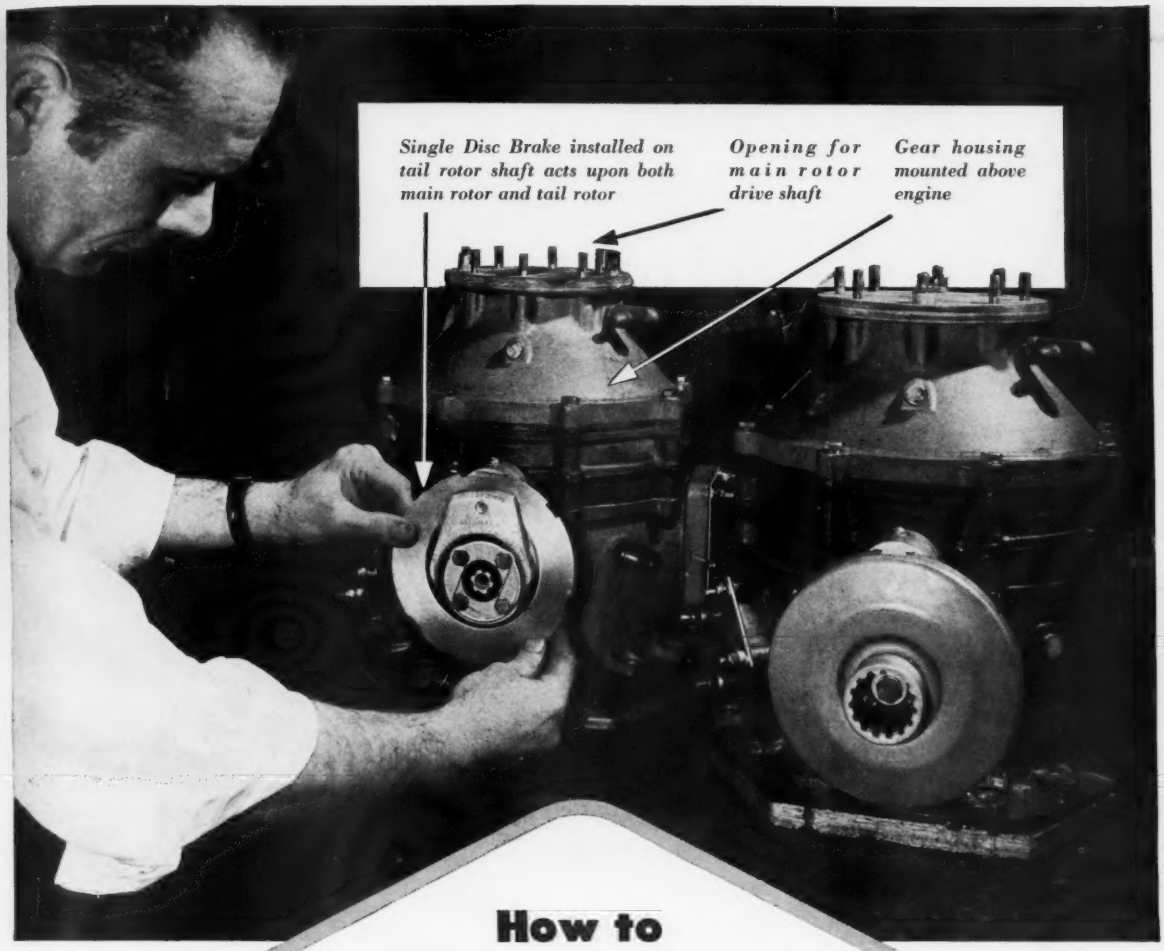
Single Disc Brake installed on tail rotor shaft acts upon both main rotor and tail rotor
Opening for main rotor drive shaft
Gear housing mounted above engine

How to brake an egg-beater

To prevent the main rotor and tail rotor from windmilling and to provide sure, smooth action and controlled deceleration necessary to prevent damaging torque stress loadings on rotor assemblies, the Bell 47-D helicopter is equipped with the new Goodyear Single Disc hydraulic rotor brake.

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FOR BETTER HYDRAULIC DEVICES

Cover—U.S.A.F. Northrop X-4 research airplane.

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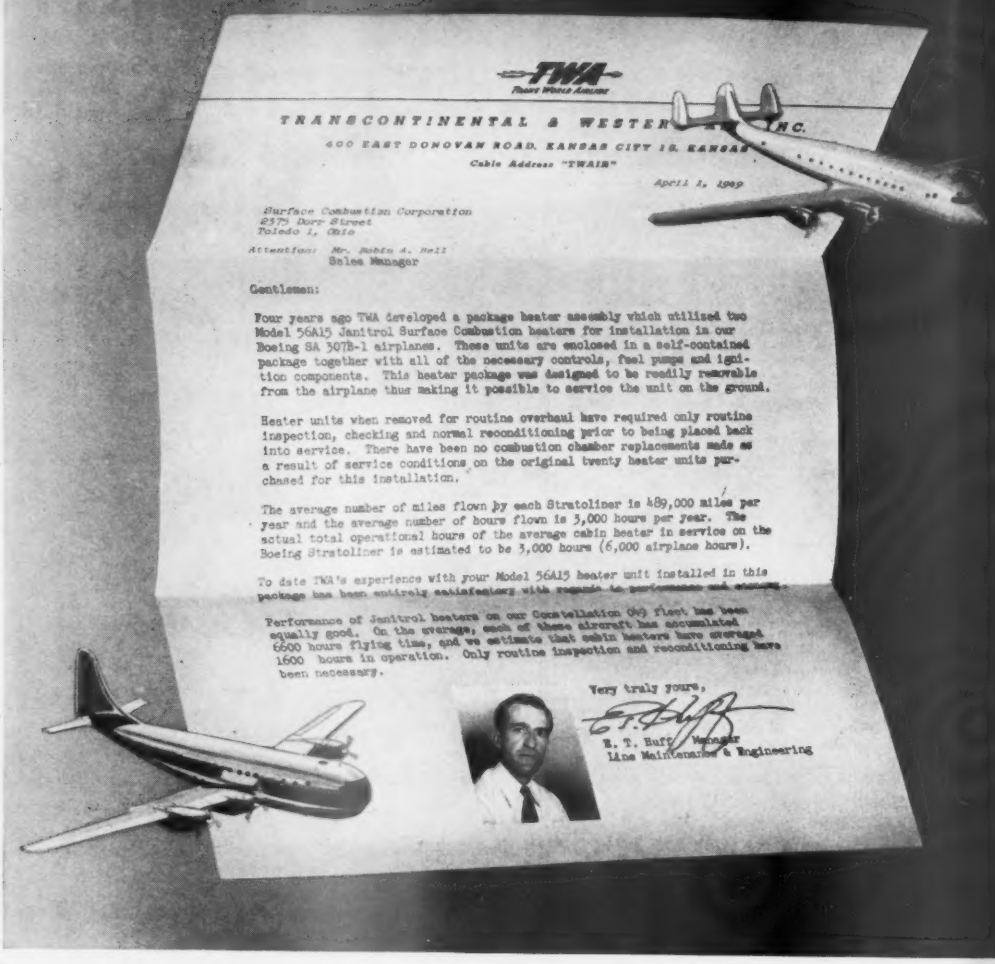

TWA
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TRANSCONTINENTAL & WESTERN [illegible] INC.
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April 1, 1949

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Toledo 1, Ohio

Attention: Mr. Robin A. Bell
Sales Manager

Gentlemen:

Four years ago TWA developed a package heater assembly which utilized two Model 56A15 Janitrol Surface Combustion heaters for installation in our Boeing SA 307B-1 airplanes. These units are enclosed in a self-contained package together with all of the necessary controls, fuel pumps and ignition components. This heater package was designed to be readily removable from the airplane thus making it possible to service the unit on the ground.

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The average number of miles flown by each Stratoliner is 489,000 miles per year and the average number of hours flown is 3,000 hours per year. The actual total operational hours of the average cabin heater in service on the Boeing Stratoliner is estimated to be 3,000 hours (6,000 airplane hours).

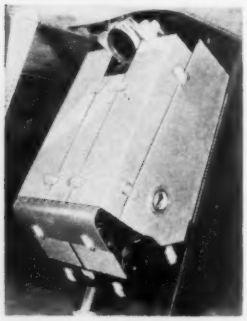
To date TWA's experience with your Model 56A15 heater unit installed in this package has been entirely satisfactory with regards to performance and economy.

Performance of Janitrol heaters on our Constellation (049) fleet has been equally good. On the average, each of these aircraft has accumulated 6600 hours flying time, and we estimate that cabin heaters have averaged 1600 hours in operation. Only routine inspection and reconditioning have been necessary.

Very truly yours,

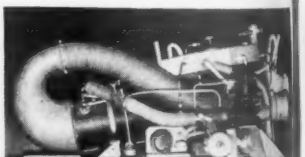
R. T. Huff, Manager
Line Maintenance & Engineering

Pair of 100,000 Btu (per hour) Janitrol heaters developed by TWA into a package for Stratoliners, easily removed from the airplane for inspection and servicing. No combustion chamber replacements have been made in original units . . . Average heater has been in operation a total of 3000 hours.



STRATOLINER • CONSTELLATION

The above letter, from one of America's finest commercial airlines, speaks for itself. It shows how teamwork between operator and supplier can lead to complete satisfaction. Janitrol cabin heaters on TWA's Connies have clocked up an average of 1500 operational hours per airplane and are still going strong. Constellation (049) cabin heater and controls shown below.



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I.A.S. News

A Record of People and Events of Interest to Institute Members

Joint Conference Is Example of Effective Partnership

Burden Declares Broader Significance of Meeting Far Transcends Purely Aeronautical Importance; Sikorsky Awarded Royal Aeronautical Society's Silver Medal.

PRESIDENT WILLIAM A. M. BURDEN in his address to the Second International Conference Dinner on May 26, attended by some 450 American and British delegates, described the meeting between the Royal Aeronautical Society and the Institute of the Aeronautical Sciences as a "practical example of effective partnership between the world's greatest air powers."

"In this uncertain world," he said, "we hear a great deal about the desirability of international cooperation, but we see few examples of it in action. That is why the broader significance of our present meeting far transcends its purely aeronautical importance."

Handley Page Speaks—Sir Frederick Handley Page, noted British aviation pioneer and principal speaker at the Dinner, removed what little formal barrier remained between English and American delegates by his humorous yet apt observations on the aeronautical and world scene, observations that acted as a counterpoise to the weighty technical sessions just ended.

A special event was the honor conferred by the Royal Aeronautical Society upon Igor I. Sikorsky, Engineering Manager of Sikorsky Aircraft Division of United Aircraft Corporation, for the noted designer's work in the helicopter field.

Sir John Buchanan, President of the R.Ae.S., presented to Dr. Sikorsky the society's Silver Medal, awarded for important advances in aircraft or engine designs. Dr. Sikorsky, I.A.S. Honorary Fellow, is the first American to receive this high honor.

In addition, Capt. J. Laurence Pritchard, Secretary of the R.Ae.S., was presented with the Honorary Fellowship scroll of the Institute, which was awarded him last January.

Mixing Up Process—The Conference demonstrated the value of what Mr. Burden called the "mixing up process" in which British and American participants got to know each other not only in the technical sessions but in informal talks throughout the meeting.

"The meticulous manner," said Mr. Burden, "in which our British colleagues have prepared major theses for this meeting—despite the demands of busy, everyday schedules—has aroused the admiration of our own engineers to a point that *I hope* will result in eventual emulation."

The August issue of the REVIEW will be devoted exclusively to the Joint Conference, containing excerpts of all Dinner and Luncheon speeches, a coverage of the technical sessions, and a pictorial presentation of social events and field trips made by the British delegates.

First American to Receive R.Ae.S. Silver Medal: *Igor I. Sikorsky, Engineering Manager of Sikorsky Aircraft, was awarded the Royal Aeronautical Society's Silver Medal for his work in helicopter design. Shown here at Second International Conference Dinner Reception, Hotel Astor, New York City, are (left to right): Sir John Buchanan, R.Ae.S. President; James H. Doolittle; and Dr. Sikorsky.*

I.A.S. San Diego Building Dedicated

THE BIG EVENT for the San Diego members of the Institute of the Aeronautical Sciences, their friends and their guests, was the dedication of the new I.A.S. building in San Diego on the evening of April 29, 1949. A California sunset greeted the early arrivals and formed a fitting pictorial backdrop for the bright new building, since it lies along the San Diego bay and directly across from San Diego's famous Lindbergh Field and is approached from scenic Harbor Drive.

The building was all in readiness for the occasion, with many beautiful floral decorations to enhance the halls and banquet tables. Befitting the occasion and the aeronautical-minded were a dozen Birds of Paradise in one display and the I.A.S. seal in blue flowers with a green background in another display donated in commemoration by local concerns. As the halls, library, lounge, and office rooms began to hum with excitement in the discovery of the features and details of the building, a great deal of praise was expressed for the beauty in the foyer of the great I.A.S. seal inlaid in the terrazzo floor and for the two bronze plaques, one with the principal donors' names and the other in appreciation to Major Reuben Fleet whose foresight made this edifice possible. The third bronze plaque of the I.A.S. seal is above the entrance to the building and becomes the monumental symbol to the organization.

At 7:00 p.m. the auditorium doors were thrown open and soon 250 people were seated at the long banquet tables and enjoying the special dinner arranged for this occasion. Once again each person discovered the I.A.S. crest on their dinner plates.

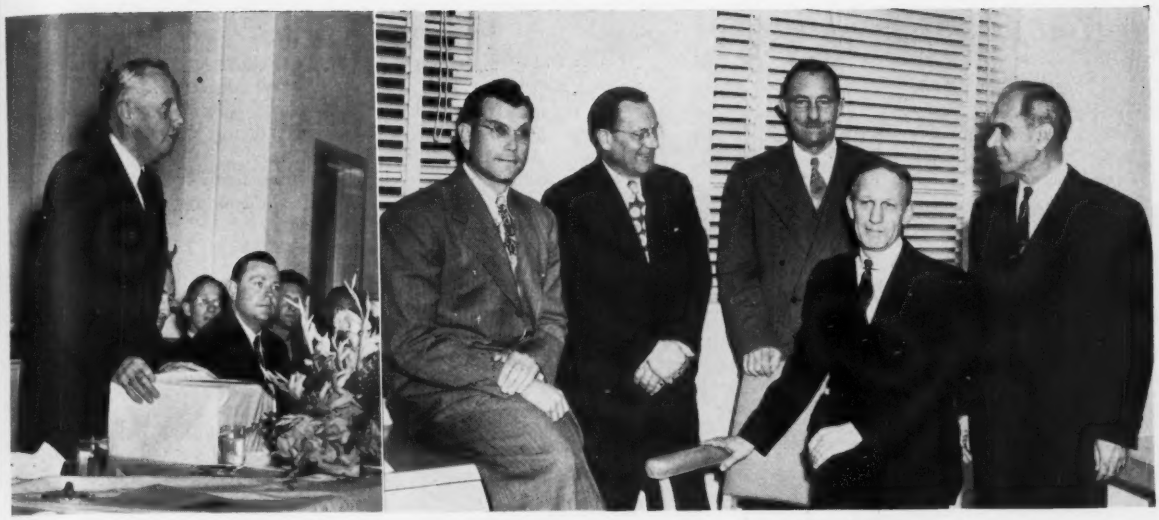
Seated at the speakers' table were the guests of honor: John K. Northrop, President of Northrop Aircraft, Inc., and immediate Past-President of the I.A.S.; Frank Fink, San Diego Section Chairman and Chief Engineer of the San Diego Division of Consolidated Vultee Aircraft Corporation; and immediately flanked by the presidents of the San Diego aircraft companies: LaMott T. Cohu, Consolidated Vultee Aircraft Corporation; T. Claude Ryan, Ryan Aeronautical Company; Edmund T. Price, Solar Aircraft Company; and H. I. Mandolf, The Langley Company. Major Fleet and Fred Rohr, President of Rohr Aircraft, the other principal donors, were traveling outside of the country and could not be present.

Seated on both sides of these men were: Ernest G. Stout, National Councilor; E. P. Rhodes, Chairman of the Building Committee; K. R. Jackman, Chairman of the Building Management Committee; James L. Straight, Assistant Director of the I.A.S.; Jack Mason, Chairman of the Dedication Committee; and the officers of the San Diego Section: Dwight Bennett, Vice-Chairman; Ralph Bayless, Treasurer; Ralph Shick, Recording Secretary; B. T. Salmon, immediate Past-Chairman; and W. T. Immenschuh, Corresponding Secretary.

After dinner, Chairman Frank Fink welcomed all who were present at this first and important meeting in the new building. Next, the important guests were introduced, and the first of these was Charles H. Colvin, member of the National Council and a Past-President of the I.A.S., who honored the San Diego Section with a surprise visit. Mr. Colvin brought with him the personal regards and best wishes for success from all of the National Officers and the New York Headquarters. Ernie Stout, long active in the planning and the realization of this building, was introduced by the Chairman and asked to relate the evolution of the new facilities.

In the spring and summer of 1944, Major R. H. Fleet, then National President, perceived the need for adequate facilities to house the Institute of the Aeronautical Sciences and brought into being the New York Headquarters and laid the plans for buildings in Los Angeles and San Diego. Major Fleet requested companies in the San Diego Area to contribute money to build, in San Diego, "a facility where scientists, engineers, technicians, and so on, can meet periodically, and often, to interchange ideas with a view to advancing the aeronautical sciences, avoiding needless duplication of effort, and assuming America's leadership in this important field." In the fall of 1944, contributions were made to Major R. H. Fleet, as trustee for the Institute.

In June, 1945, a "Contributors' Committee for the San Diego Facility of the Aeronautical Sciences" appointed by the National Council and composed of a man nominated by the president of each of the contributing companies, signed a contract with Wm. Templeton Johnson, architect, to design and supervise the construction of the facility. Prior to the signing of this contract and subsequent to it, the Building Committee of the San Diego Section, operating



John K. Northrop *(left)*, speaker of the evening at the Dedication on April 29, 1949, of the San Diego Building of the Institute of the Aeronautical Sciences. On the right, representing the major contributing companies to the I.A.S. San Diego Building are *(left to right)*: S. W. Shepard, Secretary, Rohr Aircraft Corporation; Edmund T. Price, President, Solar Aircraft Company; LaMott T. Cohu, President, Consolidated Vultee Aircraft Corporation; H. I. Mandolf, President, The Langley Company; and T. Claude Ryan, President, Ryan Aeronautical Company.

under the instructions of the Contributors' Committee, worked closely with the architect in designing the facility.

In September, 1945, preliminary plans for the building were approved by the Contributors' Committee, and the first payment was made to the architect. In November, 1945, through cooperation with the San Diego Harbor Commission, a proposed site on Harbor Drive was selected for the building.

War years and rising building costs delayed further progress until the summer of 1948, when, with a property lease finally and properly secured, the final plans for the building were completed and a contract signed with Vistendahl Inc., of San Diego, as the lowest bidder.

Signing of the contract for the building culminated 4 years' effort by Major R. H. Fleet and the Institute in a program actively supported by the City and County of San Diego, the Harbor Commission, the San Diego Chamber of Commerce, and other civic organizations. The building was substantially completed by the last week in April and the official notice of completion was filed on April 29, 1949, the cost amounting to approximately $148,000 plus $24,000 in furnishings.

Mr. Stout proceeded by thanking the many, many small contributors to the building both for their time and individual donations. Attention was then called to the acoustics evident in the auditorium. With 250 people seated comfortably, it was unnecessary for the speaker to use a public address system as everyone present testified that they hear unusually well. Credit for this effect was given to Dr. J. P. Maxfield, of the Naval Electronics Laboratory, who gave freely of his time and counsel on the acoustical material selection and arrangement. The result is an auditorium unequaled on the West Coast. It has already attracted considerable attention among architects and is to be the subject of a feature article in a forthcoming issue of the *Architectural Forum.*

A great deal of praise was given to E. P. Rhodes, Chairman of the Building Committee of the San Diego Section, for his capable work in coordinating details, continual arbitration with the

I.A.S. San Diego Section Officers and Committee Chairmen active in the building program *(left to right)*: Ernest G. Stout, National Councilor; E. P. Rhodes, Building Committee Chairman; W. T. Immenschuh, Corresponding Secretary; Jack Mason, Past-Chairman of the Building Committee and Chairman of the Dedication Committee; K. R. Jackman, Building Management Committee Chairman; Frank L. Fink, San Diego Section Chairman and Chief Engineer of the San Diego Division of Consolidated Vultee Aircraft Corporation; holding the golden key to the building, B. T. Salmon, Past-Chairman; Dwight Bennett, Vice-Chairman; Joel Whitney, Member of the Building Committee and the Contributors Committee; Ralph Bayless, Treasurer; James L. Straight, I.A.S. Assistant Director; and Ralph Shick, Recording Secretary.

HIDDEN POWER

Acting more like a fighter plane than a 40-ton craft, the Navy's first jet-powered patrol plane, the Martin P4M-1 Mercator, lifts its nose disdainfully from a wet runway after a short run. Appearing like a conventional twin-engined airplane, the Mercator hides much of its total power potential in two Allison J-33 engines mounted aft of the Pratt & Whitney Wasp Majors. According to The Glenn L. Martin Company, the jets give the Mercator additional thrust for take-off and for extra bursts of speed which enable it to close rapidly on a target after one is spotted with the electronic equipment carried. Ability to cruise on conventional power alone gives it greater range, while its maneuverability, along with its high speed and heavy armament, would enable it to dodge and slug its way to and from the target, Martin says. Note air inlets under Wasp Major nacelles which may be opened or closed according to whether jet engines are in or out of operation.

architect and the contractor, careful examination of all bids for equipment and furnishings, and continual attempts to obtain the best for the least amount of money resulting in an exceptional building.

On the day of the final inspection and accounting with the architect and the contractor, it was discovered to the amazement of all present that the actual cost of the building was *$175* less than the original contract cost. To anyone acquainted with construction costs of any kind, it is easily recognized that this was a most unusual feat.

Mr. Rhodes was asked to say a few words and he in turn introduced the architect and the contractor. Both men expressed their thanks for the privilege of participating in the design and construction of such a building, and the contractor then presented to the San Diego Section a gold key to the front door of the building.

K. R. Jackman, Chairman of the Building Management Committee, was introduced by Mr. Stout, and a brief statement was made of the plan for operation of the building. Mr. Jackman will take over where Mr. Rhodes leaves off, and he has already demonstrated his capacity for handling this most important phase of the operations.

James L. Straight, Assistant Director for the I.A.S., then expressed the great increase in services to be available to the members on the West Coast when both the Los Angeles and San Diego facilities swing into full operation and the almost immeasurable increase to the assets of the entire organization. Mr. Straight read a telegram he had just received from W. A. M. Burden, the National President, congratulating the San Diego activity for its progressive action and final realization of the building.

At this point in the program the guest speaker of the evening, John K. Northrop, was introduced. The San Diego Section was extremely honored by Mr. Northrop's presence, for it was during his term of presidency that he came to San Diego and signed the contracts necessary to start construction and offered to all concerned the encouragement so necessary in tackling such a large project. Mr. Northrop described the building as a "new tool of the industry in its dynamic drive in the evolution of the ultimate." In reviewing the broad organization and services of the I.A.S., the term "Aeronautical Sciences" was described as embracing nearly all of the physical sciences known to man in the attempt to conquer supersonic flight. Research from plastic developments to nuclear fission for power has broadened the aeronautical scope from the day of the Wright Brothers to the present at a pace unequaled by any other science.

Following Mr. Northrop's speech a movie *Operation Vittles* showing the Berlin Air Lift was presented and then the meeting adjourned.

So many lovely flowers were received that open house was held on Sunday, May 1, from 1:00 to 4:00 p.m. during which time many visitors were shown through the building.

W. T. IMMENSCHUH
Corresponding Secretary
San Diego Section

Princeton Project to Summarize Aerodynamic, Jet Data

A unique series of publications in high-speed aerodynamics and jet propulsion, designed to summarize all scientific data that have accumulated in these fields of research, has been projected by Princeton University under sponsorship of the Office of Naval Research. Both the Air Force and Army are collaborating with the Navy in the project.

▶ **Three-Man Editorial Board**—The undertaking is being planned and directed by a three-man editorial board headed by Dr. Th. von Kàrmán, I.A.S. Honorary Fellow and Chairman, Scientific Advisory Board, U.S.A.F. Other members of the board are Dr. Hugh L. Dryden, Director of Research, N.A.C.A., an Honorary Fellow, and Dean Hugh S. Taylor, Dean of the Graduate School, Princeton.

Executive Editor of the series is Dr. Martin Summerfield, Chief, Rocket Research Division, Jet Propulsion Laboratory, Cal Tech. His assistant is I.A.S. Member Dr. Joseph V. Charyk, a member of Princeton's Department of Aeronautical Engineering.

▶ **Book-Form Monographs**—In announcing the project, Dr. Harold W. Dodds, President, Princeton University, said that "scientists have long felt the need for a series of monographs, published in book form, that would assemble the wide range of information essential to the development of advanced types of rocket and jet engines and in the treatment of high-speed aerodynamic problems."

"The series," he continued, "probably running to some eight volumes and drawing upon such closely related fields as physics, chemistry, and gas dynamics, can play an extremely important role in stimulating further basic research on the theories underlying jet propulsion and aerodynamics."

Princeton, selected last fall as one of two national centers of rocket and jet study and research established by the Guggenheim Foundation, is head-

quarters for Project Squid, a program of basic jet propulsion research sponsored by the O.N.R.

Complete Consolidation of Marquardt, General Tire

Consolidation by The General Tire & Rubber Company of its two subsidiaries, the Marquardt Aircraft Company, Van Nuys, and General Tire & Rubber Company of California, South Pasadena, has been completed. The consolidated facility, known as Marquardt Aircraft Company, will be confined to the Van Nuys factory, to which all personnel and manufacturing equipment has been moved from the South Pasadena plant.

▸ **Step Toward Economy**—A. H. Rude, Managing Director of General Tire's research and development activities in Southern California, stated that the consolidation was a step toward administrative and operating economy. The Marquardt plant has a floor area of 100,000 sq.ft. and is engaged in research, development, and manufacture of ram-jet and pulse-jet engines. The South Pasadena backlog consisted of electronic and special ordnance equipment. Combined with the Marquardt backlog, this approximates $3,000,000.

General Tire's other subsidiary, Aerojet Engineering Corporation, of Azusa, Calif., also is engaged in the manufacture of jet propulsion motors, but principally in the rocket powerplant field.

New Marquardt facility is headed by Roy Marquardt, President and General Manager, and M. M. Gilman, Executive Vice-President. Remaining as Chief Engineer is Don Walter, I.A.S. Technical Member.

National Meetings Calendar

July 21–22	Annual Summer Meeting, Los Angeles
Dec. 17	Wright Brothers Lecture, Washington, D.C.
Jan. 23–26, 1950	Eighteenth Annual Meeting, New York.

For details see page 77

M.I.T. Fellowships

The Department of Aeronautical Engineering, Massachusetts Institute of Technology, has announced five fellowships for 1949–1950 in support of graduate study in aeronautical science or engineering as follows:

Richard C. du Pont Memorial Fellowship in aeronautical engineering, for a graduate student in any year of his work toward an advanced degree; tuition plus $1,200 single, $1,800 married.

Douglas Aircraft Company Fellowship, for a graduate student; $1,500.

Goodyear Tire & Rubber Company Fellowship, for a graduate student; $1,500.

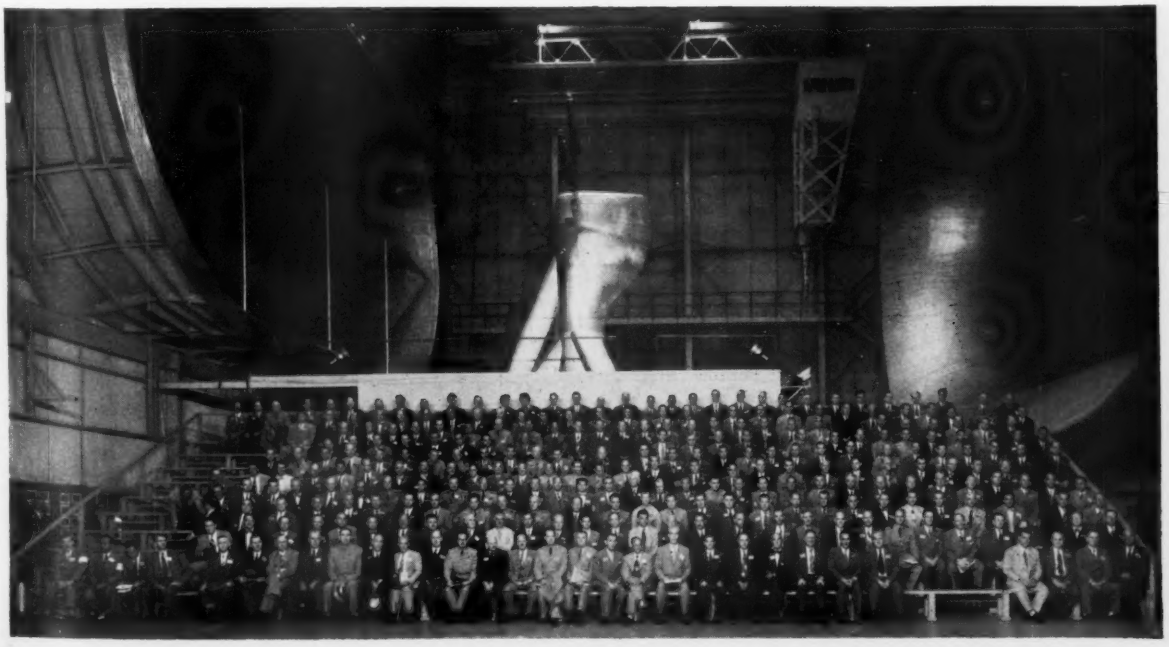
Requirements for admission to the Graduate School and application forms may be obtained from the Director of Admissions. For particulars regarding awards, appointments, stipends and duties, and possible part-time employment on sponsored research, write Prof. J. C. Hunsaker, Department of Aeronautical Engineering, Massachusetts Institute of Technology, Cambridge 39, Mass.

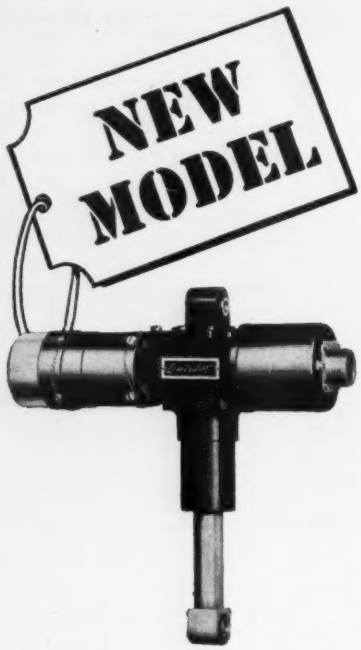
Two West Coast Firms Join I.A.S. Community

The Earle M. Jorgensen Company and Sturgess, Inc., two Los Angeles firms, have joined the Institute as Corporate Members, it was announced in May.

▸ **Steel Distributor**—The Jorgensen company maintains warehouses for the distribution of steel in Los Angeles and Oakland, Calif., and Houston,

1949 Biennial Inspection of Langley Aeronautical Laboratory: *With typical efficiency and dispatch, N.A.C.A. put on an impressive show this year at Langley for numerous groups of distinguished visitors. The I.A.S. was well represented on the visitation of May 18, with Institute officials and members accounting for a majority of the faces to be seen in the picture below.*





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  1—General Electric D.C. Selsyn 3 wire Type 8TJ9 for use where accuracy independent of voltage fluctuations is desired
  2—Potentiometer for use with voltmeter indicator or for "bridge" circuit control
- "Center" or Intermediate Position Switch.
- Integral Instruction Plates for adjustment of Limit Switches and Transmitter
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Tex. A new warehouse is expected to be opened shortly in Dallas.

The firm carries a complete line of steel items covering about 10,000 different shapes and varieties. Included is a complete stock of steels used in the aircraft industry. Where necessary, Jorgensen says, these particular steels conform to all required specifications.

A division, the Earle M. Jorgensen Company—Forge Division, operates a 1,000-ton forge press in Los Angeles. The press is used primarily for producing heavy bar press forgings.

Jorgensen was founded about 25 years ago in Los Angeles by Earle M. Jorgensen, President.

▸ **Accessory Manufacturer**—Sturgess, Inc., develops and manufactures accessory equipment for aircraft. Company employs 50 persons.

Sturgess is presently supplying the aircraft industry and Air Force with the following: Cable Tensiometers, for measurement of tensions in aircraft cables and wires over a range of from 0 to 5,000 lbs.; Cable Tension Regulators, for automatic regulation of the tension on control cables (they compensate for all forces tending to increase or decrease tension, including temperatures, structural deflection, wear, cable stretch, etc.); Auto Rig Disconnects, a small unit making it possible to disconnect and reconnect secondary control cables such as engine throttle, etc., in a matter of seconds and at the same time setting the predetermined tension in the cable upon reconnection and providing a take-up for variations in cable lengths; and Adjustable Seat Locks. Sturgess has different designs of mechanical locks for use on reclining aircraft seats. These units provide positive locking at any position with easy release and override of the lock at specified loads in either direction required.

In addition, the company is developing further aircraft accessories as required and is interested in any problems of mechanical and hydraulic regulation of any aircraft parts, as well as any other mechanical equipment pertaining to aircraft.

I.A.S. Newslines

▸Repeat Performance. . .**Dr. Hugh L. Dryden,** Honorary Fellow and N.A.C.A. Director of Research, who gave the 1949 annual Wilbur Wright Memorial Lecture in London before the Royal Aeronautical Society April 28, repeated the Lecture on May 19 in Washington, sponsored by I.A.S. Washington, Baltimore, Hagerstown, and Philadelphia sections. Title of the talk, "The Aeronautical Research Scene—Goals, Methods, and Accomplishments," covered exploration of new fields, evaluation of test procedures, research as foundation for advanced development, and support of specific applications.

▸Giannini Director. . .**Luis de Florez,** wartime Rear Admiral and former Director of Special Devices Division of the BuAer, has been elected a member of the board of directors of G. M. Giannini & Company, Inc., Pasadena, Calif., manufacturer of guided missiles and supersonic aircraft instruments. Admiral de Florez, who heads the de Florez Engineering consulting firm, is an I.A.S. Fellow.

▸Joins Philco. . .**William H. Klenke, Jr.,** Associate Fellow, who resigned from Consolidated Vultee after Convair's disposal of the Stinson Division, of which he was General Sales Manager, has been named Special Representative for the Electromaster Division, Philco Corporation, covering the Southwest, with headquarters in Los Angeles. Home address is 200 South Windsor Blvd., Los Angeles 4, Calif.

▸Celestial Training. . . .Additional Civil Aeronautics Administration Safety Agents now are training in advanced celestial air navigation so that they can certificate the navigators required for the increasing number of long-range scheduled air-line trips, especially overocean hops, says **Del Rentzel,** C.A.A. Administrator and I.A.S. Honorary Member.

▸B-36 Replacement. . .Air Force is "designing the first replacement" for the B-36, according to **Gen. Hoyt S. Vandenberg,** U.S. Air Chief of Staff and I.A.S. Honorary Member, in a speech before American Legion in Indianapolis.

Necrology

Paul E. Richter

Associate Fellow Paul E. Richter died of a cerebral hemorrhage at the age of 53 on May 15 last.

▸ **Air Transport Pioneer**—A former executive Vice-President of Trans World Airlines, Mr. Richter was a pioneer in the formation of scheduled air-line service with Jack Frye in 1926. Following his resignation from T.W.A. in April, 1947, he was elected Chairman of the Board of TACA Airways in October, 1947, and later became its President.

In 1948 he was selected one of a group of air-line executives who had served in the war assigned to aid in working out the merger of Air Transport Command and Naval Air Transport Service. During the war he had served as operations officer for N.A.T.S. with the rank of Commander.

Born in Denver, Colo., he attended the Colorado Agricultural College and

in 1918 enlisted in the Army. He was commissioned a 2nd Lieutenant.

After the war he operated a ranch for a time in Colorado and then left in 1924 for California, where he entered commercial aviation.

▸ **Qualified Pilot**—After he qualified for his pilot's license, he was a commercial pilot at Burdette Airport. He also was one of the original "13 Black Cats" of Hollywood stunt flyers, and, with Jack Frye and Walt Hamilton, he ran a barnstorming and aerial taxi company which gave way to the Aero Corporation of California in 1926. The three later formed Standard Airlines in 1928, which operated a single-engined Fokker between Los Angeles, Phoenix and Tucson, El Paso and Dallas.

In 1931, Western Air Express absorbed Aero Corporation and Standard, and T.W.A. was formed, with Mr. Richter becoming Western Region Superintendent of Operations. He rose to Vice-President—Operations in 1934, and 2 years later was Executive Vice-President and Director.

Corporate Member News

• Allison in Fourth Place . . . **Allison Division** of General Motors is claimed to rank fourth in total sales volume among the country's manufacturers whose principal products are aircraft or aircraft components. From standpoint of degree of approach to wartime peak sales, Allison is first, according to E. B. Newill, General Manager, and Vice-President of G.M.C. Sales are now divided with about 75 per cent for aircraft engines and components and 25 per cent for nonaviation products. Allison operates six plants in Indiana with total of 6,000,000 sq.ft. of floor area and 8,000 employees.

• B-36 Pod Subcontract to Bell . . . A subcontract for $4,000,000 worth of jet engine "pods" for the B-36 has been let to **Bell Aircraft Corporation** by Convair. Bell already is building an identical power pack for Boeing's B-47, although a part of this job was cut back by Boeing because of cancellation of the B-54 program by Air Force . . . Bell has dropped plans to acquire American Wheelabrator and Equipment Company, of Mishawaka, Ind., and Baker Refrigeration Company, of South Windham, Me.

• Final negotiations for transfer of four Boeing Stratocruisers from Scandinavian Airlines System to British Overseas Airways Corporation were concluded in Seattle last May at the **Boeing Airplane Company** plant. Addition of four planes brings to ten the total Stratocruiser order under construction for British "Speedbird" fleet. Original six B.O.A.C. Stratocruisers were ordered in 1946; all ten are to be delivered this year. . . . Boeing reported a net profit after taxes of $577,017 for first quarter ending March 31. Sales for the period were $55,195,130. Cost of sales and other expenses, including prorata writedown of Stratocruiser inventory, was $54,118,979. Other income amounted to $80,363, and other deductions, including interest, were $219,497 . . . C-97A has been approved at new gross weight of 148,000 lbs.

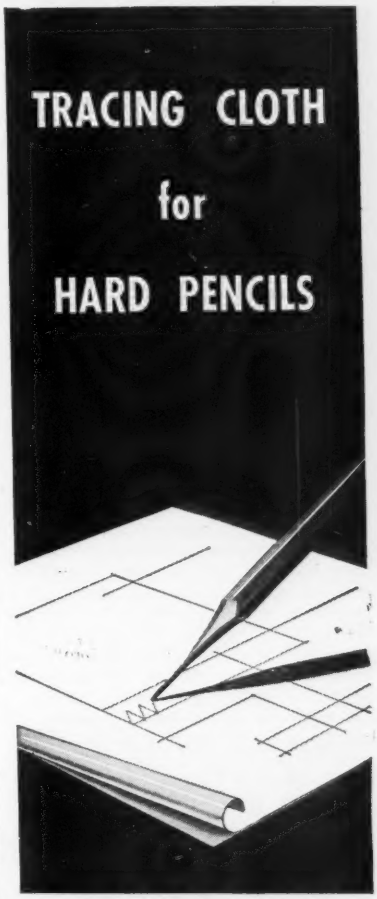
• Canadair-Four Deliveries Beat Schedule . . . Last of four Canadair-Four aircraft ordered by Canadian Pacific Air Lines for its transpacific services to Australia and the Orient was delivered the first of this month by **Canadair Ltd.**—five months ahead of contract requirements. Fully pressurized and air conditioned, the Four has maximum cruising speed of 325 m.p.h. For long Pacific run, seating arrangement accommodates 36 passengers in sleeper-type, fully reclining seats.

• "Avitruc" Up for C.A.A. Approval . . . **Chase Aircraft Company, Inc.,** West Trenton, N.J., filed application with C.A.A. for an approved type certificate for Model MS-7B twin-engined Avitruc, a 32,000-lb. transport and cargo plane. Full carrier approval is sought. Several domestic and foreign air carriers have shown interest in the civilian version of the plane, Chase says.

• End of Red Ink . . . Reduction in the number of **Consolidated Vultee Aircraft Corporation** board members from 17 to 14 and election of two new members was announced at annual meeting in San Diego. Said Board Chairman Floyd B. Odlum: "Insofar as our financial outlook is concerned, it is evident we have turned the corner. Our profit and loss statement for the first quarter of this year," he added, "showed earnings of slightly less than $1,000,000 and I am happy to emphasize to you that this turn for the better in our affairs brought to an end twelve successive quarterly reports all written in red ink."

• Auto Part Maker . . . So successful has been **Douglas Aircraft Company's** Western Pressed Metal Division that it expects to be engaged soon in the manufacture of parts for new cars assembled in Pacific Coast factory assembly plants. Division also is turning out plumbing supplies, metal furniture, and trailer parts and has backlog of $120,000. Harry Woodhead is head of the Division.

• High-Speed Impellers in One-Piece Cast . . . The casting of shrouded, high-speed impellers in one piece, with such complete control of critical dimensions and surfaces that machining and balancing are almost totally eliminated, is now possible through a new process recently developed at Teterboro, N.J., foundries of **Eclipse-Pioneer Division,** Bendix Aviation Corporation. Known as Bendix plaster mold



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casting, new process is said to be not only adaptable to mass production requirements but can, at the same time, be used to turn out parts with complex inner construction; will consistently maintain critical uniformity and wall thickness; and is capable of producing satin-smooth finishes wherever desired on either internal or external surfaces. Increase in structural strength is claimed, and improved performance is pointed out by Eclipse-Pioneer foundry engineers in such parts as impellers where peripheral speeds up to 1,500 ft. per sec. generate tremendous centrifugal forces.

• Air Force Accepts C-119 . . . Air Force has accepted first production model of Fairchild C-119 Packet, designed and built by **Fairchild Aircraft Division,** Fairchild Engine and Airplane Corporation. Latest of the Flying Box Car Line, C-119 production models will succeed 220 C-82 planes previously delivered to Air Force. Total of 144 C-119's are to be built under existing contract. Eight, designated R4Q, will go to Navy.

• New Aircraft Energizer . . . A new, portable heavy-duty aircraft energizer was announced by **General Electric's** Small and Medium Motor Divisions. New energizer is specifically designed to provide regulated 28½-volt ground power supply for starting all types of reciprocating engines, as well as variable voltage power supply for starting jet engines. In addition, G-E says, unit is equally desirable for supplying electrical power to aircraft before take-off, for use in shop and hangar areas, and for facilitating production tests on jet engines and aircraft. Important feature is "soft start" provided by the control which minimizes strain and shock on starting mechanism.

• "Don't Overlook Younger Generation" . . . According to **The B. F. Goodrich Company,** there is no reason for a depression in the U.S. if managers of industry and business will put to work all the energies and talents of inspired salesmanship at their disposal. Return of conditions to so-called "buyers' market" should be welcomed by alert business management, Goodrich says. In studying millions of people in the country as potential buyers, do not overlook the younger generations, which comprise about one-third of the population. They have been used to prosperity and do not remember anything about depression. About 15,000,000 potential customers have been added during past decade, Goodrich states.

• F9F Subcontracting . . . About 30 per cent of its F9F jet fighter production has been subcontracted by **Grumman Aircraft Engineering Corporation**—Martin receiving about $4,000,000. Bell and Curtiss-Wright were in negotiation as we went to press.

• An order for 100 three-bladed reversing Hydromatic propellers, 13 ft. in diameter, is being fulfilled by **Hamilton Standard Propellers Division,** United Aircraft, for Canadair Ltd. Props are being installed on Canadair-Four transports ordered for B.O.A.C. and Trans-Canada Airlines.

• South Africa Buys Connies . . . Purchase of four new-type Lockheed Constellation Model 749 aircraft for use by South African Airways resumes a long-standing commercial relationship between **Lockheed Aircraft Corporation** and Union of South Africa. Lodestars were standard equipment for the government air line before the war. With orders now on its books, Lockheed's Connie production line, which has never shut down since commercial production began in 1945, is assured of continued activity through May, 1950. Total of 179 Connies sold since the war have logged 4,000,000,000 passenger-miles in scheduled air-line ervice, carrying 75 per cent of air traffic between U.S. and Europe.

• Clipper Cargo Gains . . . Despite more rigid controls by Latin American governments on international trade, volume of Clipper cargo carried by **Pan American World Airways'** Latin American Division continues its steady gains, Pan Am says. Ton-miles flown during first quarter January–March, 1949, totaled 5,180,000, compared to 4,650,000 in first quarter last year and 3,165,000 during same period in 1947. P.A.A. has added a fleet of ten C-46 cargo Clippers to fly Latin American routes.

• Outstanding Safety Record . . . A bronze plaque was presented to **Pratt & Whitney Aircraft Division** of United Aircraft by Liberty Mutual Insurance Company for P. & W.'s outstanding safety record—2,321,554 man-hours without lost-time accident. Period covered was between November 23, 1948, and December 19, 1948, and ended when a worker dropped a 30-lb. lathe slide on his knee and foot. Division's accident and illness rate for 1948 was only 5.6 injuries or illnesses per each million man-hours. Latest available data shows that in 1947 entire U.S. aviation industry has injury-illness rate of 7.14 per million man-hours.

• Republic's First Quarter Net . . . **Republic Aviation Corporation** reported its net income, after taxes, was $254,055 for first quarter 1949. Sales for the period were $9,706,107. April 1 backlog was $50,000,000. Company is producing F-84E Thunderjet, 409 of which are ordered.

• Navion Price Boosted . . . Price of four-place Navion was raised by $1,020 to total of $11,005 f.a.f. San Diego by **Ryan Aeronautical Company.** Reason—costs of producing improved 1949 model in labor hours and equipment ran higher than original estimates. New price took effect May 1.

• S-52 Cops 'Copter Speed Record . . . A Sikorsky S-52-1 helicopter, powered by a 245-hp. Franklin engine, established new world speed record for rotor craft at 129.616 m.p.h. Piloted by Harold Thompson, engineering and demonstration pilot for **Sikorsky Aircraft Division,** United Aircraft, the S-52-1 flight was made at a measured course in Cleveland Airport. Speed was average of four consecutive down-and-up wind passes over the course out of total of eight runs. Record was made despite torn streamlining on tail rotor boom and gusty 17-m.p.h. west wind.

• Thompson Nets Profit . . . Consolidated net sales of **Thompson Products, Inc.,** for quarter ending March 31 were $25,226,286, compared with $23,532,185 for first 1948 quarter. Consolidated net

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profit for the 1949 quarter amounted to $996,950, or $2.06 per share of common after provision for preferred stock dividends.

• Big Customer . . . **United Aircraft Corporation** spends nearly $600,000 a year with the air lines as a customer. During 12-month period, about $595,000 was paid for air-line tickets and air freight, express, and mail by United and its four divisions. Passenger tickets accounted for $370,000.

• Denver U.A.L. Nerve Center . . . Routing for **United Air Lines'** entire fleet of 143 aircraft over a 10,700-mile system now is controlled at company's Denver operating base. Transfer of the routing of Mainliner 180's (DC-3's), effected in May, completed the centralization. Altogether, counting both twin-engined and four-engined equipment, Denver office routes and follows 160 daily flights, exclusive of special operations and extra sections, nearly half of which are en route simultaneously during peak daytime periods.

• Wright Reports Loss . . . **Wright Aeronautical Corporation** reported a loss of $1,093,020 for three months ended March 31. Net sales for the period amounted to $15,163,042. Operating results for first quarter reflected retroactive price decreases of $420,000 determined in this period, relating to shipments of the prior year, and to a greatly accelerated program of research and development.

Meet Your Section Chairman

Crittenden P. Steele

Seattle Section

The air age first dawned on Crittenden P. Steele about 1920, when he became aware of aeronautics at the age of 5 at Fort Benjamin Harris, Ind., where his father was stationed at the time.

Because the Indianapolis Speedway was, at that time, used as a Repair Depot for the Army Air Forces, he saw a great many pilots and aircraft.

Although Mr. Steele has served in the armed services as a 1st Lieutenant, and presumably has had his share of moving about, and despite the tendency of the Pacific Northwest to be subject to geologic epilepsy, he has shown a fondness for the place of his birth, Seattle, where he was educated and where he is Senior Group Engineer at the Boeing Airplane Company.

▶ **Worked on B-17's**—Eleven years with Boeing—Seattle, Mr. Steele supervises the design and installation of electrical equipment, autopilots, radio, and radar in Boeing planes.

During 1945 he was Liaison Engineer for Boeing at Douglas and Lockheed on the B-17 Flying Fortress, famous bomber that played so great a part in reducing Festung Europa in World War II.

A graduate of the University of Washington, where he received his B.S. in Aeronautical Engineering in 1937, Steele joined Boeing the following year and has been with the company ever since, rising from Draftsman to Group Engineer to his present post. One of the most interesting of his studies while with Boeing, he says, was the investigation of the possible installation of a 115-volt d.c. electrical system in modern aircraft.

In addition to his membership in the I.A.S., he is a Member of the American Institute of Electrical Engineers and the Reserve Officers Association. For relaxation he likes to play tennis or squash or go fishing.

I.A.S. Sections

Baltimore Section

Don K. Covington, Jr., *Secretary*

Speaker of the evening at the April 13 meeting was Comdr. T. D. Davies, U.S.N., Office of the Chief of Naval Operations. Commander Davies is known for his long-distance record flight in the Truculent Turtle P2V, designed by Lockheed Aircraft.

▶ **Flight of the Turtle**—Commander Davies described the flight of the Truculent Turtle, giving the performance figures and other outstanding information. He then proceeded to the subject of the address, "Technology as It Relates to the Science of Warfare."

He stressed the need of aeronautical engineers today to set their sights on the economics of warfare and machines rather than on the possibilities of advancement in warfare technology.

A lengthy discourse was presented on the Navy's job—i.e., the importance of sea and mobility on economics of warfare and machines. The Navy's prime mission, Commander Davies said, is to close the range. He also pointed out that some 12,000 Japanese aircraft were shot down in the Pacific war; the ratio of carrier planes to enemy aircraft shot down was 18.4 Japs to 1 American. Of Japanese planes, 93 per cent destroyed were land-based type, he declared.

Buffalo Section

Alexander Krivetsky, *Secretary*

Members, with George Ray, Chairman, presiding, heard T. P. Wright speak on "Safety in Aircraft Operation" at the April 26 meeting. There were 50 members present. Dr. Wright, who is Vice-President for Research, Cornell University, is also President of the Cornell Aeronautical Laboratory, Inc.

▶ **1948 Accident Rate Lowest**—In his talk, Dr. Wright divided the basic fields of safety into the airplane, the air, and the human factor.

Statistics from 1930 to 1948, he said, have shown that on scheduled air lines there is an ever decreasing rate of accidents per 100,000,000 passenger-miles. An accident rate of 1.3 per 100,000,000 passenger-miles, indicated in 1948, is the lowest in air-line history, Dr. Wright said, and since 1940 the air-line rate has been below the automobile's but still above bus and railroad accident rates.

Nonscheduled air lines, according to the speaker, show a greater accident rate than the scheduled lines because route familiarity is not present, because no regular flights are in effect, because pilot requirements are lower, and because maintenance along the route is not usually available.

▶ **Breeder of Accidents**—However, Dr. Wright declared, private flying is the greatest breeder of accidents, the rate being 30 more than scheduled lines, or one out of 85 personal planes have an accident each year, producing about 26 fatalities per 1,000 personal aircraft.

At present, he said, the personal plane is a fair-weather vehicle, since the incorporation of various automatic devices would make the cost of personal flying prohibitive. Because accidents in private flying primarily occur in take-off and landing, use of a shoulder harness would save approximately 75 per cent of the lives involved in accidents, the speaker concluded.

(*Continued on page 69*)

The Cargo Constellation

...an airplane with a world of experience

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Lockheed

LOOK TO LOCKHEED FOR LEADERSHIP

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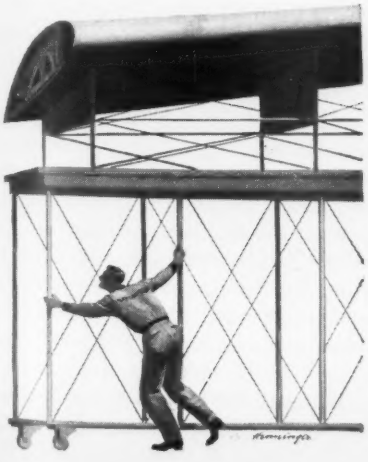


News of Members

David P. Chappell, who was Stress Analyst at McDonnell Aircraft, has enrolled in the University of Oklahoma where he is obtaining his B.S. in M.E.

Wilbur H. Day is an Aerodynamicist for Link Aviation, Inc., in Binghamton, N.Y.

Frederick C. Durant, III, has returned to active duty as a Lieutenant Commander in the Naval Reserve. Formerly with Bell Aircraft Corporation, Lt. Comdr. Durant is Director of Engineering at the Naval Aeronautical Rocket Laboratory, Lake Denmark, Dover, N.J.

A. J. Ferguson, Technical Assistant, British Overseas Airways Corporation, has been transferred from London, England, to Filton Aerodrome, Bristol. Home address is 75 Radstock Rd., Woolston Southampton, England.

John J. Konikoff is now Project Specialist, Specialty Division, Aviation Armament Laboratory, U.S. Naval Development Station, Johnsville, Pa.

Raymond J. Korczyk is Engineering Draftsman for Beech Aircraft Corporation. Home address is 357 N. Emporia, Wichita, Kan.

Cameron M. Lusty was promoted to Chief Engineer of the Aircraft Division, Globe Corporation, Joliet, Ill., from Assistant Chief Engineer.

Miles James Mraz is with the Chicago Aerial Survey as a Designer. He was a Designer with North American Aviation. New home address is 1810 S. 59th Ave., Cicero 50, Ill.

Robert B. Phillips, formerly Supervisor of Aeronautical Training of Duval County in Jacksonville, Fla., and Teacher of Aeronautics at Landon High School in Jacksonville, has joined National Airlines in Miami as Instructor.

Frank N. Piasecki, President, Piasecki Helicopter Corporation, delivered a paper, "Engineering Problems of the Helicopter," at the first International Aeronautical Industries Meeting in Paris last May 12. In addition, he attended the British Industries Fair in London and visited helicopter and aircraft plants in England, France, Switzerland, Italy, and Spain. In Madrid he met Dr. Th. von Kármán, U.S.A.F. Research & Development Consultant.

James I. Porter is now a Partner in the firm of Irwin S. Porter & Sons, Washington, D. C.

Charles J. Schell, Jr., has been promoted from Sr. Draftsman—Airframes to Aerodynamics Engineer by The Glenn L. Martin Company, effective last May 1.

Ronald L. Shecker is Engineering Draftsman "B" at North American Aviation, Inc. New address is 618A Venice Way, Inglewood, Calif.

Dean C. Smith, former Representative in Washington for Hughes Tool Company, has been named Director of Contracts Administration, Hughes Aircraft Company, Culver City, Calif.

Irving A. Sofen, formerly a Research Analyst with North American Aviation, is now an Electrical Engineer for Houston Corporation, Los Angeles. New home address is 2723 Thurman Ave., Los Angeles 16, Calif.

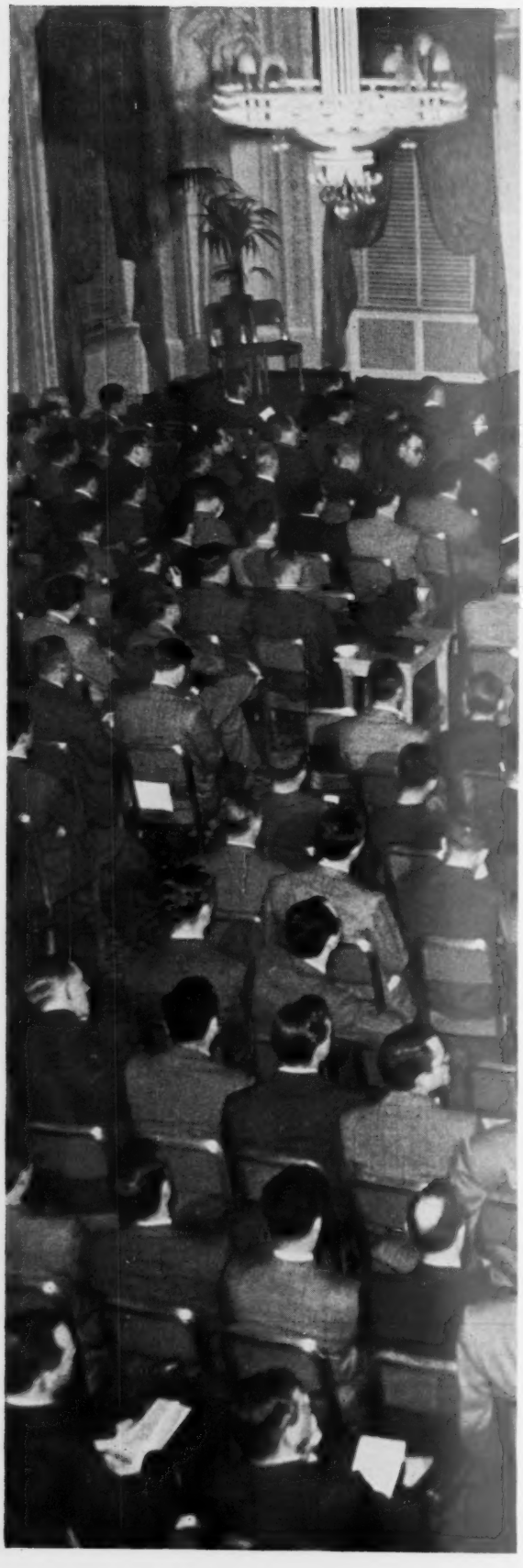
Robert H. Wendt, formerly Chief Engineer, Aircraft Division, Globe Corporation, Joliet, Ill., has been elected Vice-President in Charge of Engineering.

HANDLEY PAGE ASSISTANT

C. Anthony Chapman, who was appointed Technical Assistant to Sir Frederick Handley Page of Handley Page Ltd., London, England, last February, formerly was Design Engineer at A. V. Roe Canada Ltd., Malton, Ontario, Canada. New London home address is 30 Tavistock Court, Tavistock Sq., W.C. 1.

AWARDED DEGREE

Thomas L. K. Smull, Head of Research Coordination, National Advisory Committee for Aeronautics, Washington, D.C., was awarded an Honorary Degree of Doctor of Science in Aeronautical Engineering by Ohio Northern University at Commencement Exercises on May 29. Dr. Smull worked for both the President's Air Policy Commission and the Congressional Aviation Policy Board.



For Better Presentation

The Second International Conference of the Institute with the Royal Aeronautical Society has come and gone. The story of the meetings and the other phases of the joint program is told in this and later issues. The preparation of the proceedings and the discussion of the various technical papers is going forward. It will take some weeks, if not months, before a full evaluation of the event can be made.

Meanwhile, however, there are several points on which immediate comment may be helpful—particularly with reference to the preparation and discussion of technical papers. In spite of such excellent efforts as Willis Hawkins' little book, *Your Audience Has High Hopes* (which was widely distributed last year), and the constant efforts of our Secretary and of various meetings committees, it is obvious that there is still wide variation in the quality of technical papers read before I.A.S. meetings. Entirely apart from the substance of the report, its acceptability, from the standpoint of the audience, is largely a matter of how well it is prepared and presented and how thoroughly it is discussed.

We have learned a great deal from our Royal Aeronautical Society contemporaries in this respect. It is apparent that the *average* British paper has been subjected to more thought and effort from the earliest stages of preparation than is given to the *average* American paper. There are, of course, obvious exceptions both ways—but, on the whole, our friends from England generally make better presentations than we do. Perhaps more kudos is attached to the reading of a paper in England than in America. Perhaps the early training of engineers there has something to do with it. Possibly, too, advance rehearsal helps. We know, for example, that several British lecturers spent many hours on shipboard en route to America, practicing the delivery of their papers before groups of critical friends.

Editorial

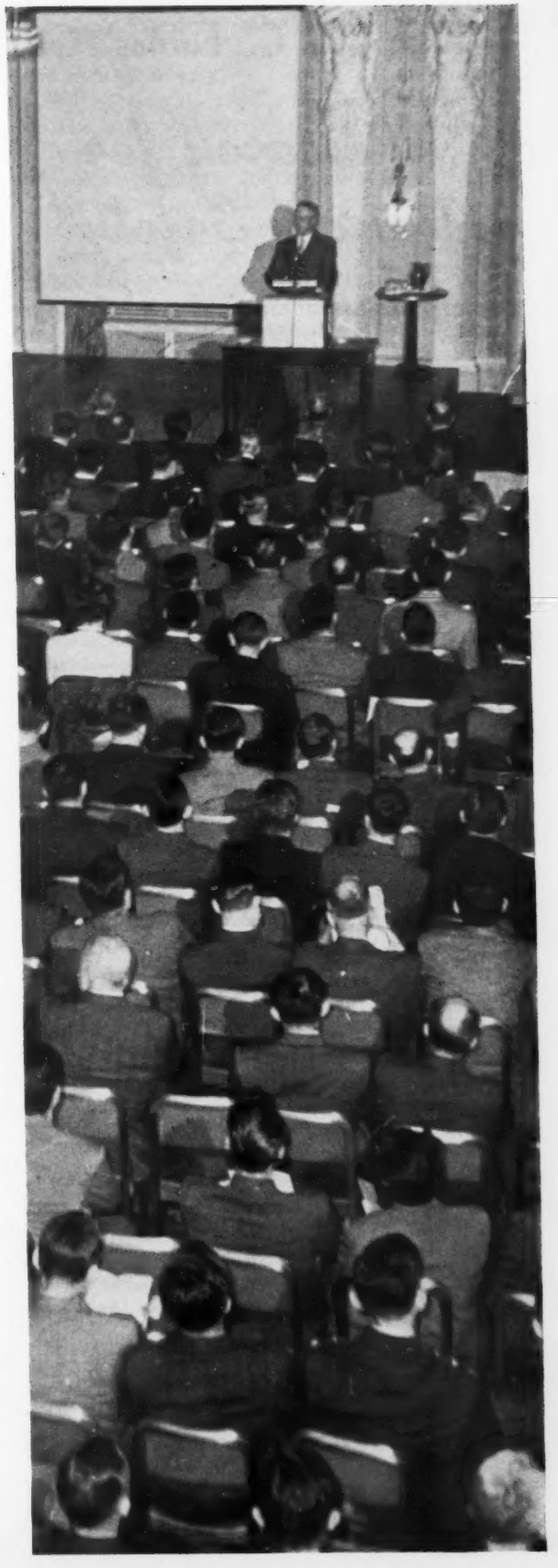
Too often, over here, the finishing touches are put on our papers en route to meetings, on trains or planes, or in hotel bedrooms the day of the meeting. Too often, also, an otherwise good paper is spoiled by inept presentation.

Then, in matters of discussion, our British cousins are certainly more adept than are we. Here, we are sure, the matter rests on training and custom. From school days on most educated Englishmen are accustomed to debate. By analyzing and searching for the flaws in the other fellow's argument, they bring to light facts that may have been overlooked or underemphasized. We are not advocating argument for the simple sake of arguing, but it is true that much more importance is attached to the discussion of a paper in England than in America. The more people who jump into active debate of the points of a paper, the better they like it. We are too often prone to let a paper go by with little, if anything, beyond a few casual questions—and it is generally our loss.

Part of the trouble lies in the general inarticulateness of the American engineer—his general reluctance to stand on his feet in public and to express his views. This is a fault of our engineering training and should be corrected. Some of the trouble, we must admit, lies also in the preparation of programs for our meetings. We tend to crowd too many papers into a single meeting, and the result is usually a push to get through the program with a minimum time allowed for discussion.

And so, in the interest of better meetings, we may well take a leaf from the R.Ae.S. notebook and try to better both the preparation and the discussion of our papers. If a subject is worth bringing to the attention of an Institute meeting, it is surely worth the time for adequate preparation by the author, and program committees and meeting chairmen should see to it that adequate time is allowed for a full discussion of the subject as presented. Both authors and audience alike will be the beneficiaries.

S. P. J.



Dr. C. C. Furnas*

on

"Research for Aircraft Safety"

Dinner Address at Sixth Annual Personal Aircraft Meeting, Wichita, Kan., April 29

DURING THE YEARS 1944–1948 inclusive, on the commercial air lines of the United States, there were 2.02 passenger fatalities for every 100,000,000 passenger-miles flown.[1] Data on personal flying are meager because the number of miles flown are indefinite, but such data as are available indicate that the fatality rate per passenger-mile, exclusive of instructional periods, is about 30 times as great as for commercial air lines. In 1946, one in 85 registered personal airplanes was involved in a fatal accident.[2] For comparison it should be cited that the average accident rate for private automobiles during a comparable period has been 2.65 fatalities per 100,000,000 passenger-miles; for buses, 0.20; for railroad passenger trains, 0.21.[1] Thus commercial passenger planes are safer than private automobiles, but personal planes are relatively dangerous devices, and all forms of aircraft are in serious need of improvement—as far as safety is concerned.

In the past the aeronautical industry has been seriously prone, in many quarters, to avoid consideration of safety rather than face the issue. During the past 2 years, however, the trend has changed and safety consciousness is widespread. There is a realization that a great deal of research is needed, as well as engineering, manufacturing, and operational improvements. This paper is concerned primarily with the research aspects.

The problems of aircraft safety can be roughly divided into three categories:

(1) Structural and operational integrity of the aircraft in the air.

(2) Prevention of collisions or crash landings.

(3) Ameliorating the effect of crashes when they do occur.

These items are not always mutually independent, since the effects and results of each are frequently cross-linked, but they can serve as a basis for discussion.

Integrity of Aircraft

Though structural and power-plant failures are not now the major bugaboos they were in the early days, such mishaps do occur often enough to be significant in the "Cause of Accident" column. In the years 1938–1946, of the 309 domestic scheduled air-carrier accidents, 10.3 per cent were attributed to power-plant failure and 12.6 per cent to structural failure.[1] During the same period there were 34,614 noncarrier air accidents, of which 13.6 per cent were listed under power-plant failure and 5.0 per cent under structural failure.[1] Although all accident statistics must be viewed with a certain skepticism because of difficulties of achieving accuracy and because of the factor of multiple causes, such data as those referred to above do indicate a fruitful area for improvement. Weick has made an excellent detailed analysis of the 1,353 personal-plane accidents associated with engine failure in the year 1947.[3] His study indicated that, where causes were known, seven-eighths of these accidents were attributable to some failure of the fuel system. That report certainly highlights a field for investigation.

The integrity of structure and power plants of present commercial and private aircraft are not, however, a field that calls for any major amount of research. Rather it is an area where there should be more intensive development pointed toward improvement. Research is the acquisition of new knowledge, and presently available knowledge is probably adequate to solve the remaining problems as completely as possible if sufficient development effort is expended.

As new aircraft and new power plants come into use, a great deal of research is required to provide the knowledge necessary to achieve satisfactory integrity. In jet power plants there is still much to be learned before materials are completely satisfactory and integrity can be assured. New alloys for aircraft construction call for extensive research, particularly on fatigue and corrosion resistance. Research along these lines is being

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vigorously pursued in a number of places. This should give assurance that tomorrow's aircraft should be safer than those of today.

The problems of flutter and other aeroelastic phenomena have been fairly well solved, mostly by trial-and-error methods, for the present transport airplanes. As larger and faster transports are designed, however, the problems arise anew and are more severe. They are of great importance in some of the new military aircraft now under development. Extensive theoretical, laboratory, and flight research is being pursued under military auspices at the present time. My own organization, the Cornell Aeronautical Laboratory, is carrying on a substantial amount of activity of this character, and such work is being pursued in various other quarters.[4]

The occurrence of fires in the air is another item that calls for attention in this category. Although they occur but seldom, at least in the well-proved aircraft, the effect is so terrifying and the results so severe that it is a matter of prime importance. About 5 per cent of air-carrier accidents are caused by fire in flight.[5] The problem itself is difficult of solution because of the great compactness that is required of equipment and because, in aircraft, the amount of fuel handled and the rate of energy release is so much greater per unit of volume than in any other transportation device.

While the bulk of the solution can probably be achieved by systematic thought and engineering, there are some items of research which still need to be investigated. The first of these is the matter of fire prevention by maintaining an atmosphere of inert gas in fuel tanks and the surrounding areas.[6] Another item that can bear further exploration is improved material for extinguishing fires when they do occur. Carbon dioxide and methyl bromide are being used for this, but they both have serious shortcomings. A paramount need is a really satisfactory fire detector. None has yet been developed which has the desired reliability. Too frequently, they fail to operate, or they give a warning when no fire is occurring, either of which situations obviously tends to detract from their effectiveness.

Considerable research has been performed on nonflammable lubricating oils, but the results thus far are not hopeful. More success has been had in developing nonflammable hydraulic fluids. Several of these bear considerable promise for utilization in the near future.

The exploration of so-called "safety" fuels is potentially fruitful but has not resulted in any phenomenal advances as yet. It must be remembered that fuel is, by definition, something that will burn, and, hence, there are certain conditions of temperature, exposure to oxygen, and any source of ignition which will make it a fire hazard. Although it is conceivable that a fuel could be developed which would burn only under conditions found inside an engine and under no combination of conditions which could be found outside, there is no real hope of complete success along this line. However, the stakes are so high that it is worthy of continuing investigation.

The N.A.C.A. is particularly active at the present time in fire-prevention research at the Lewis Flight Propulsion Laboratory in Cleveland. A number of research projects on the basic phenomena of aircraft fires are under way which will undoubtedly improve the picture in the future. The C.A.A. also has a comprehensive research program at Indianapolis.

Until recently, the problem of icing conditions frequently reared its ugly head. Thanks largely to the pioneering work of Rodert and others at N.A.C.A.,[7] sufficient research work was accomplished to point the way to practical solutions now being used, particularly heat deicing. A great deal of adaption and development will be required before personal aircraft can meet all icing conditions, but enough knowledge is now at hand to point the way toward feasible solutions by the engineers and manufacturers.

Adequate dynamic stability and control are obviously paramount to the integrity of operation of any flying machine. For the most part, the problems of dynamic stability and control have been solved, in the past, by purely empirical methods. However, the newer high-performance planes, particularly in the military field, call for a more sophisticated approach, and considerable theoretical and flight research activity is under way.[8] This research will undoubtedly have beneficial effects on the integrity of design and operation of future commercial and personal aircraft. This is particularly true of research that is being done on the dynamics of the stall.[9]

The stall is turning out to be a predictable and, perhaps, a controllable phenomenon. This may eventually lead to the saving of many lives of people who fly in light aircraft, for some 45 to 50 per cent of the fatalities in light airplanes are attributable to stall spins.[2]

Prevention of Collisions and Crash Landings

The key to success in the prevention of collisions or crash landings is primarily one of knowing where you are and what you are doing. This matter, of course, has been made much more difficult because of the increasing requirements for all-weather operation in both the commercial and military fields. With the present integrity of aircraft, if flying operations were confined to fair weather, the accident record would probably be of much smaller proportions. Although about 45 per cent of the air-line accidents are attributed to pilot error, the bulk of these are really attributable to emergency situations, arising during poor weather conditions, which human beings cannot reasonably be expected to handle. It has been estimated that, if these emergencies based on weather were eliminated, about 40 per cent of the present accidents would never happen.[2] The problem of the future is vitiated by steadily increasing traffic density in both military and commercial operations. It is fairly obvious that an adequate solution lies in the various electronic devices with suitable adjuncts which will give a requisite amount of intelligence and a proper degree of communication and control.

As far as mass traffic is concerned, a certain amount of operational research is indicated and is already under way in certain quarters.[10] Such research essentially involves the mathematical solution of the optimum pattern of bringing in a variety of aircraft of different characteristics, originally distributed at random, to a given spot for landing. The operations must be accomplished with a minimum of interference and probability of collision.

The Air Navigation Development Board is embarking on an extensive program of research and development to achieve a satisfactory nation-wide air traffic control system within the next 15 years.[11] It has been estimated that the research, development, and implementation of a satisfactory all-weather traffic control system for this country is going to require the systematic and wise expenditure of about $1,300,000,000 over a period of years. This gives some idea of the magnitude of the problem of replacing the human eye with inanimate devices. This is admittedly a great many dollars, and it might appear to some to be out of proportion to the value to be gained. It should be pointed out, however, that there are some $90,000,000,000 of private and public money already invested in our various transportation systems and that $30,000,000,000 were spent in this country in 1948 for transporting goods and people, $642,000,000 of this going to the certificated air lines.[12]

Thus the proposed investment of 1.3 billion dollars over a period of a number of years is by no means out of proportion if, as is strongly indicated, it will lead to marked improvements in the safety, efficacy, reliability, and extent of use of the air for commercial, military, and personal traffic.

The A.N.D.B. plans call for the development of an interim system, to be operative within 5 years, employing the most usable features of presently available systems and devices such as G.C.A. (ground controlled approach), I.L.S. (instrument landing system), and omnidirectional ranges. Other devices for both communication and control which are already well along in development, though not yet in actual use, will undoubtedly be incorporated. The evaluation of the many possibilities is already under way. The ultimate system will involve extensive research, some of it of basic character. For instance, more must be known about the fundamentals of propagation of electromagnetic radiation before communication and control systems can be made reliable for all weather. Improved servo systems, perhaps employing new principles, must be evolved. The whole closed loop of airplane-atmosphere-mechanical control-pilot must be much better understood and much better controlled than at present. Some of the background research is already being initiated on this program, but it must go much farther and call on the efforts of many organizations before any inkling of the character of the ultimate system can be obtained. The whole program represents a major step toward the day when aviation will really come of age.

Alleviation of the Effect of Crashes

The accident record of air transportation is much too heavily loaded with accounts of total fatalities of those on board. Admitting that when crashes do occur they are usually at a relatively high speed, there is still no inherent reason why the dire effect of crashes on the human occupants cannot be greatly alleviated. The magnitude of the problem is indicated in Table 1, which gives approximate data on the ratio of fatalities to injuries for various forms of transportation. It is seen that, though the air carrier operation is remarkable for its small number of fatalities, it fares the worst in this comparison. The ratio of fatalities is extremely high. This is probably because the speed at the time of a crash is usually much higher than for light airplanes, trains, or cars.

TABLE 1
Ratio of Fatalities to Injuries (Various Forms of Transportation) in Continental U.S.

Ratio:	Fatalities / Serious Injuries	Fatalities / Total Injuries	Fatalities / Survivors
Air Carriers	5.32[a]	1.81[a]	0.20[a]
Personal Planes	1.45[b]		0.10[b]
Railway Passenger Trains		0.034[c]	
Automobiles		0.029[d]	

[a] Five-year average 1943–1947: *C.A.A. Statistical Handbook*, p. 94.
[b] Two-year average 1946–1947: C.A.B., *A Statistical Analysis of Noncarrier Air Accidents*, October 11, 1948, p. 3.
[c] For years 1936–1945: *Statistical Abstract of the United States*, 1947, p. 525.
[d] For year 1946: *Encyclopedia Britannica Book of the Year 1947*, p. 18.

A substantial amount of research is under way at the present time to alleviate the effects of crashes. Hugh De Haven, Director of the Crash Injury Project at the Cornell Medical College, has, over several years, investigated in detail the causes and effects of almost a thousand light-airplane crashes. His findings have pointed the way to fruitful subjects for research and for practical advice on design modifications and utilization of safety devices. For instance, many lives would be saved per year among the personal fliers if shoulder harness and stall-warning indicators (both of which are available) were universally used. A safety control wheel has been developed which experience has shown to be safe in the event of a crash rather than a lethal device. Research and development knowledge by itself means little. The engineer, manufacturer, and user must apply the knowledge or its possible utility is lost.

The Crash Injury Project has also indicated fruitful lines of physiological research. For instance, almost 75 per cent of the fatalities in the cases investigated were primarily caused by head injuries. This ratio probably holds for other types of aircraft accidents. These and other findings have been instrumental in stimulating research to determine the limitations of the human body, particularly the head, in withstanding impacts or extremely high decelerations.

Another aspect of the investigation involves the determination of feasible engineering criteria which should make it possible to design air frames and aircraft interiors so that the bulk of the energy of a crash will be absorbed by the destruction of the structure itself while the occupants are subjected to a uniform deceleration that will not be fatal.

Preliminary work on simulated head forms at the Cornell Aeronautical Laboratory has indicated that the average human head can survive an impact energy of 600 in.lbs. when striking a hard surface. A head striking a yielding surface can withstand a considerably higher impact, depending on the mass and stiffness of the surface that is struck. From these experiments it has been found the average head should withstand, without fracture, a change of momentum of 5.3 lb.sec. during the period when the yielding surface is being accelerated up to the velocity of the head. Another general criterion that has been established is that the deceleration the head can withstand without fracture is dependent on the bearing area of the surface that is in contact with the head. The experiments cited above were conducted with simulated head forms that were thrown free—not attached to any body structure. Preliminary experiments on a simulated complete body form have indicated that the forces occasioned by the inertia of the complete human body in a crash would be about twice those involved in crashing the head alone. Although these data do not yet constitute complete engineering criteria, they do represent the type of information that should soon be available for those interested in designing safe airplanes.

Although complete evidence is not yet at hand, the present indications are that the average human body can, if properly supported, withstand decelerations of well over 50*g* for a short period without the results being fatal. This would indicate that, in an airplane designed for optimum safety of the occupants, it should be possible to have a crash at 100 m.p.h. in which the total uniform deceleration distance is only 7 or 8 ft. and still have all of the occupants survive. It would appear that, if light aircraft were designed for maximum safety, most of the present fatalities occurring in this type of flying could be eliminated. It should also be possible to make equally great advances in the air-carrier survival record.

Another obvious hazard in crash landings is that of fire. About 15 per cent of air-carrier accidents are crashes followed by fire.[5] Although this has many companion aspects to the problem of fire in the air, there are certain special features. Usually, the disastrous fires on the ground are associated with the bursting of fuel tanks or the connecting conduits. A really crashproof fuel tank would be a great improvement in this direction. This is probably too much to hope for, but developments are under way for increasing the crash resistance of fuel tanks, and probably the results will be beneficial. The principal source of ignition of fuel or other inflammables in crashes appears to be hot exhaust pipes. If exhaust-pipe surfaces could be kept below the auto-ignition temperature of fuels and oils, a substantial number of fires would not occur. Another suggested approach applicable to medium-range transports is the placing of all the fuel well out on the wings or in wingtip fuel tanks. With such an arrangement the fuel could be automatically jettisoned and well removed from the fuselage if a fire did occur. This is an approach that has considerable promise.

It would appear that it is not only possible but feasible, by designing for safety, to make as great a relative improvement in the survival record of the individuals in air crashes as occurred in the railways when the change was made from wooden to steel coaches. This would represent a substantial increment of progress.

The Cornell University work on aircraft safety briefly outlined above is planned, coordinated, and integrated by a Cornell Committee for Air Safety Research, which has representatives from the Cornell Medical College at New York, the University at Ithaca, and the Cornell Aeronautical Laboratory at Buffalo. Safety research calls for the combined knowledge and cross-fertilization of so many branches of knowledge that a joint attack is the obvious way to arrive at satisfactory solutions.

In compiling the foregoing information I make no pretense of having completely covered the field of air safety research; a complete treatise would be very voluminous indeed. I have only tried to touch on the more significant items, cite some pertinent examples, and point out the trends. Many agencies, both Governmental and private, are carrying on extremely valuable work in both research and applications. Flying is about the most difficult and involved thing that man has ever attempted. It is not surprising that he has lagged behind in the important aspects of reliability and safety. However, now that the problems are being faced squarely, the elements of required solutions are becoming well understood, and substantial amounts of financial support are forthcoming, we may look forward with considerable confidence toward rapid and significant advances within the lifetime of all of us.

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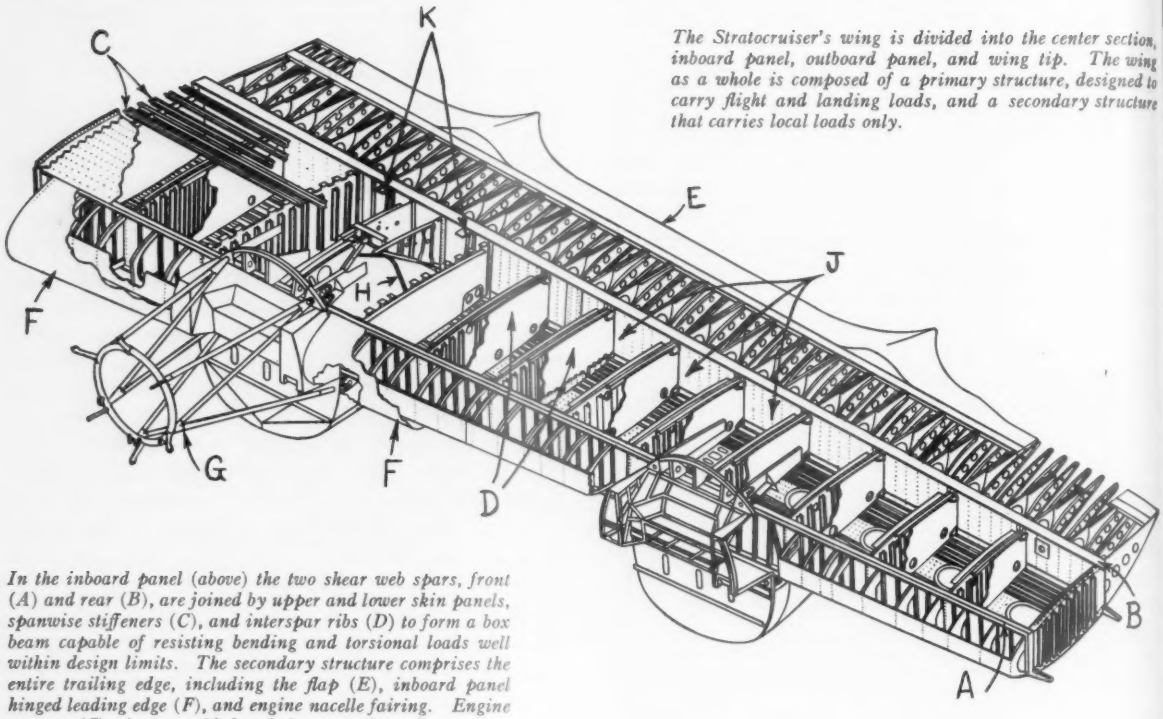
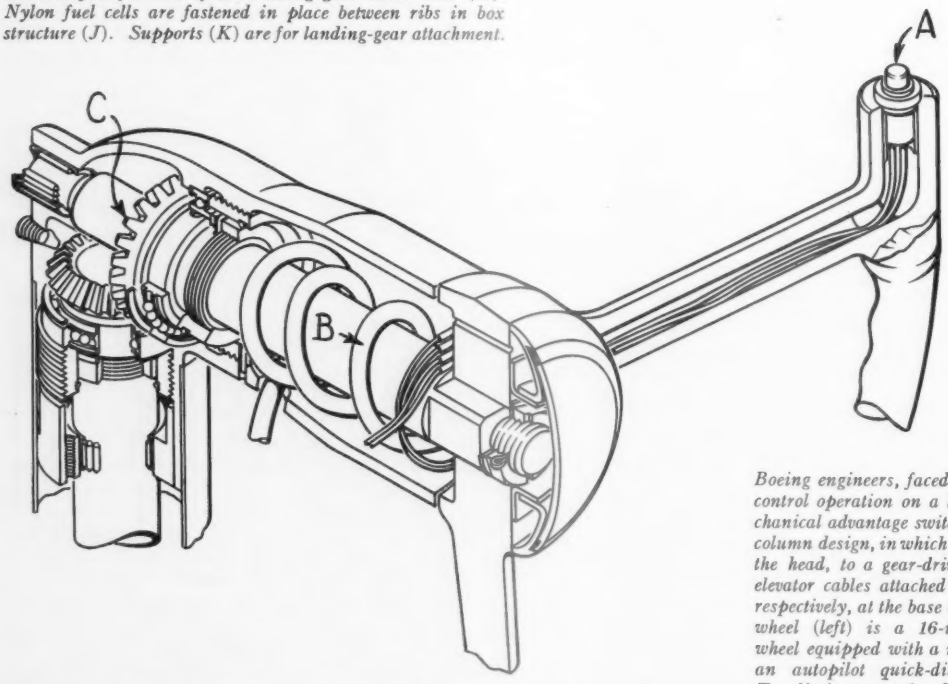
Design Trends



The Stratocruiser's wing is divided into the center section, inboard panel, outboard panel, and wing tip. The wing as a whole is composed of a primary structure, designed to carry flight and landing loads, and a secondary structure that carries local loads only.

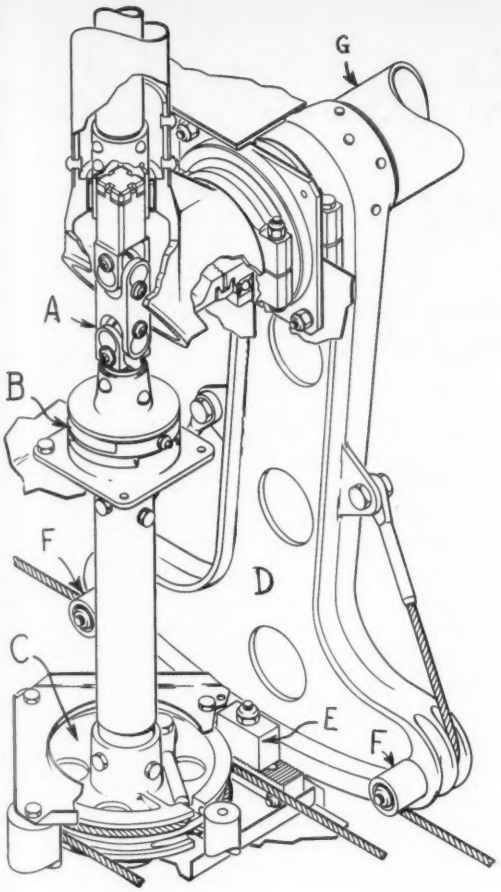
In the inboard panel (above) the two shear web spars, front (A) and rear (B), are joined by upper and lower skin panels, spanwise stiffeners (C), and interspar ribs (D) to form a box beam capable of resisting bending and torsional loads well within design limits. The secondary structure comprises the entire trailing edge, including the flap (E), inboard panel hinged leading edge (F), and engine nacelle fairing. Engine mount (G) is a welded tubular cantilevered structure mounted just forward of the landing gear wheel well (H). Nylon fuel cells are fastened in place between ribs in box structure (J). Supports (K) are for landing-gear attachment.



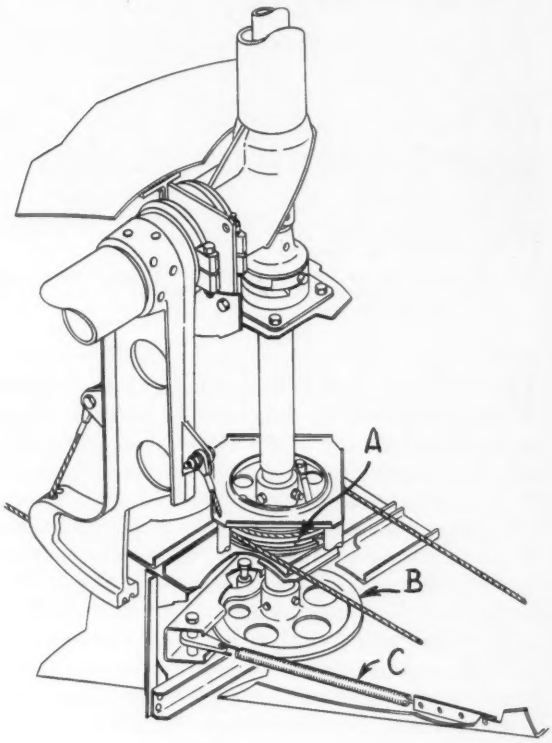
Boeing engineers, faced with the problem of flight control operation on a large plane, to gain a mechanical advantage switched from the usual control column design, in which control cables went up into the head, to a gear-driven type with aileron and elevator cables attached to a drum and quadrant, respectively, at the base of the column. The control wheel (left) is a 16-in. diameter plastic half-wheel equipped with a microphone button (A) and an autopilot quick-disconnect button opposite. To eliminate static, Boeing changed over from slip rings to electrical contact wires (B) wrapped round the wheel shaft. Miter gear (C) changes direction of control. Wheel hub is removable from shaft for inspection or maintenance.

Boeing Stratocruiser Design Details

Wing Structure and Control Column

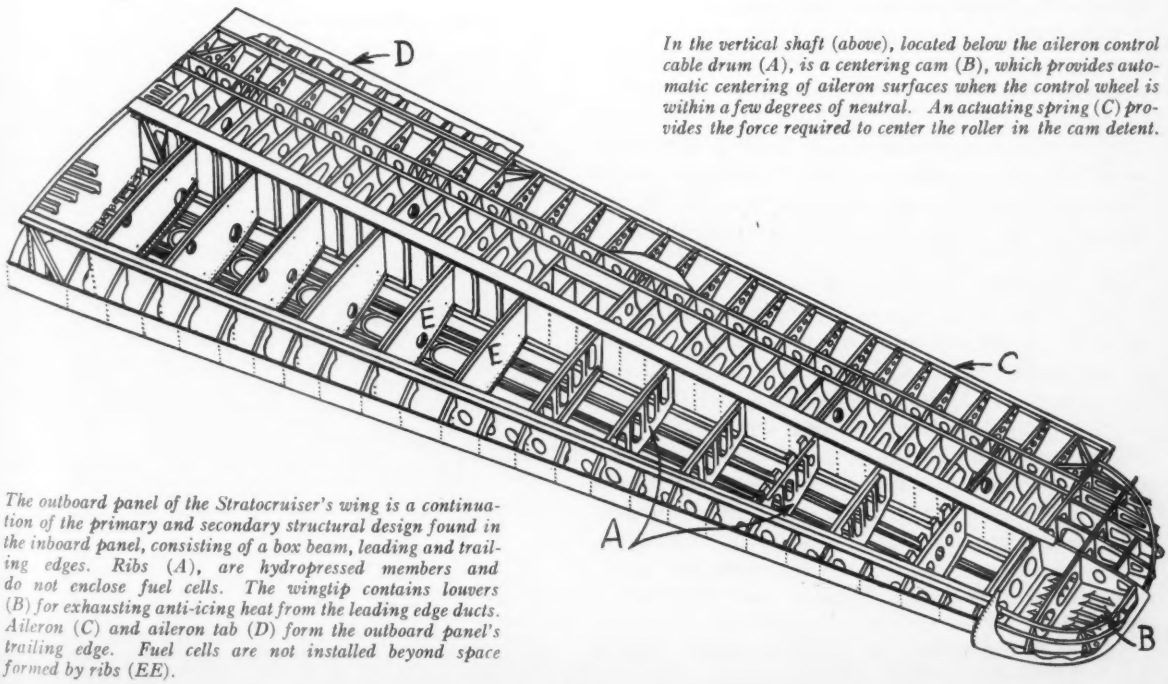


The control column (left) contains an antiback-lash feature in the universal (A) in the vertical shaft. The control column multiple stop (B) restricts control wheel travel to 400°, thus permitting travel in excess of 360°. It consists of two fixed stops, one on the shaft and one mounted to the structure. Both are separated by a floating stop. Hence, as the shaft stop rotates, it picks up the floating stop and travels until it contacts the fixed stop. Aileron control cables are $^{3}/_{16}$—7 × 19 and run from the drum (C) through pulleys, fairleads, and pressure seals out to the rear spar of each wing. By forward or aft pressure of the control wheel, the pilot controls elevator movement through the elevator quadrant (D), which is an integral part of the column. Elevator quadrant adjustable stop (E) and other quadrant stops (F) restrict its travel. The elevator torque tube is at (G).



Boeing Stratocruiser Design Details

In the vertical shaft (above), located below the aileron control cable drum (A), is a centering cam (B), which provides automatic centering of aileron surfaces when the control wheel is within a few degrees of neutral. An actuating spring (C) provides the force required to center the roller in the cam detent.



The outboard panel of the Stratocruiser's wing is a continuation of the primary and secondary structural design found in the inboard panel, consisting of a box beam, leading and trailing edges. Ribs (A), are hydropressed members and do not enclose fuel cells. The wingtip contains louvers (B) for exhausting anti-icing heat from the leading edge ducts. Aileron (C) and aileron tab (D) form the outboard panel's trailing edge. Fuel cells are not installed beyond space formed by ribs (EE).

Personal Aircraft for Military Purposes

Excerpts from a Three-Part Address "Requirements from the Army Field Forces for Commercial Model Personal Aircraft"*

PART 1
Background and History of Army Light Aviation

By

Lt. Col. Claude L. Shepard

Training Section, Office, Chief, Army Field Forces, Fort Monroe

FIRST OF ALL, on behalf of General Devers and the Department of the Army, I want to thank you for inviting Major Long, Major Cogswell, and myself to attend your meeting. Secondly, I want to make certain that you understand that the opinions that the three of us express to you this morning are not necessarily those of the Department of the Army. However, our statements do represent our best thoughts and intentions on our phase of light aviation activity within the Department of the Army. Our coming to your meeting and our talk has been cleared for security purposes by the Department of the Army, but I want to emphasize that we are expressing our opinions as individuals rather than stating official Department of the Army policy.

Major Long, Major Cogswell, and myself may be considered "past," "present," and "future." I will deal with the past; Major Long, the present; and Major Cogswell, the future.

We in the Army are extremely interested in the light aircraft industry because, insofar as light airplanes are concerned, your industry is literally the goose that lays our golden eggs, only the golden eggs in this case already have their wings.

We in the army use your light airplanes to perform a variety of missions: observation, reconnaissance, adjustment of artillery fire, aerial photography, column control, aerial evacuation of wounded, aerial wire laying, messenger service, and courier service.

These missions are not new to the Army. Ever since the days of Alexander the Great, Ghengis Kahn, and Caeser, opposing commanders have used every means at their disposal to find out as much information as could be learned about their enemies by using spies, observation towers, and mountain observation posts. Napoleon used the first crude form of aerial observation during the French revolution by sending an observer up in one of the early balloons.

During World War I, the United States Army utilized captive balloons and observation airplanes for this purpose. During the period between World War I and World War II, much effort was expended by the Army Air Corps in developing improved balloons and high-performance observation airplanes flown by Army Air Corps pilots and carrying Field Artillery officers as observers.

In 1942, the Chief of Field Artillery succeeded in obtaining authority from the War Department to assign "cub-type" airplanes, flown and maintained by artillery personnel, to Field Artillery battalions, because these airplanes proved to be so useful during the Carolina Maneuvers in 1941 and during subsequent field service tests conducted by the 2nd Infantry Division at Fort Sam Houston, Tex., and the 13th Field Artillery Brigade at Fort Bragg, N.C. We are all familiar with the Taylorcraft L-2, the Aeronca L-3, the Piper L-4, and the Stinson L-5, which were used extensively throughout World War II to perform a multitude of missions for the Army.

Initially, there were many scoffers within the Army and the Air Force. Many officers predicted that the light airplanes could not live in combat because they would be so easily shot down by enemy antiaircraft fire or by enemy fighters. The scoffers had sufficient justification for their doubts, because the light airplanes had not yet been used in combat operations. The scoffers admitted that light airplanes could be used to adjust artillery fire at Fort Sill and could be used for observation of the "enemy" on maneuvers, but these same scoffers among the Army and the Air Force felt that assigning these slow unarmored and unarmed airplanes to the Artillery was ridiculous. They predicted too that the Army would give up the use of their small airplanes as soon as the Field Artillery attempted to use them in combat, with prohibitive losses.

The predictions of the "doubting Thomases" were almost verified in the Tunisian campaign. American Field Artillery units of the United States 2nd Corps and the 13th Field Artillery Brigade had a few L-4 Piper Cubs. Much to everyone's surprise it was found the L-4's could evade enemy fighters successfully by diving near to the ground and "flying the contours" down gullies and ravines in the mountains of Tunisia. It was

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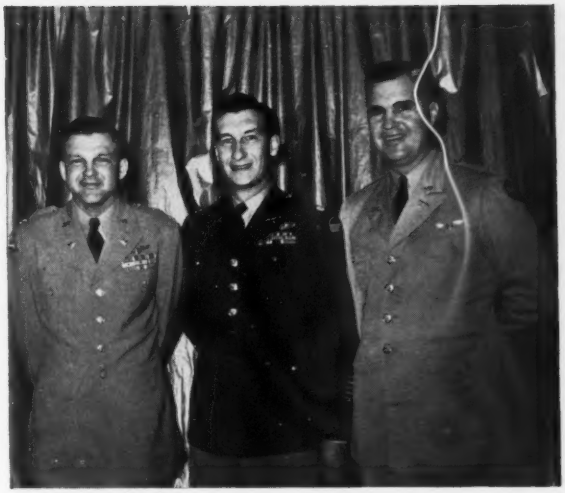
found also that the light airplanes were harder to hit with antiaircraft fire than they looked.

During the initial phase of the invasion of North Africa at Fedala, three L-4's of Third Division Artillery were launched from the aircraft carrier U.S.S. "Ranger" on the morning of the invasion 50 miles from shore. But the Cubs had no sooner left the flight deck of the "Ranger" when Naval escorting cruisers fired on them with their antiaircraft guns. The three Field Artillery cubs ran the gauntlet of Navy antiaircraft fire to the landing beaches where our own Army assault units on the beach continued the hail of fire. One airplane was shot down, one made a forced landing near the beach, and one actually reached the race track at Fedala, where one of my classmates waiting for the airplanes also opened fire on the Cub in all the confusion. This unfortunate incident proved to be a blessing in disguise, because all the Army units in Africa heard rumors of the incident and, through the incident, learned that our own Field Artillery units actually had light airplanes in Africa. Stringent orders were issued by General Eisenhower prohibiting our troops from firing upon any light airplane under any circumstances; and from that time our light airplanes could fly anywhere over our troops with little fear of being shot down by our own troops—an important morale factor for our pilots, needless to say.

The L-4's emerged from the Tunisian campaign successfully. They proved that they could live in the field and in the air in ground combat operations, and they proved to be of much use to our commanders in Tunisia because they were used frequently to fly General Eisenhower, General Bradley, and General Patton around the battlefield, from command post to command post, and thus save each of them many precious hours that would have been required if these commanders had made the trip by jeep or command car with the roads jammed with traffic, guns, and tanks.

Soon after the Tunisian campaign the light airplanes vindicated themselves in the Sicilian campaign. One hundred light airplanes were used by General Patton's Seventh Army Field Artillery units. They were used so successfully for adjustment of artillery fire, for route reconnaissance, and for silencing enemy artillery just by flying overhead that they became firmly established within the United States Army as a necessary piece of artillery equipment. It was one of the strange sights of the war to see L-4's flying back and forth, parallel to our lines, from dawn to dusk maintaining a close watch on the enemy and reassuring our doughboys below that they were being looked after. Although the light airplanes were unarmed, unarmored, and unprotected while patrolling the front lines, they controlled more Field Artillery fire power on the ground and they could hit the enemy as hard and as effectively as a squadron of B-17's.

From that time on, as the Army became more experienced with light airplanes, the story of the Sicilian campaign was repeated over and over in every combat theater in every part of the war in which United States troops were committed. The light airplanes were extremely useful in the mountains of Italy. They were credited with saving the Anzio beachhead. They were equally useful on the Continent of Europe and especially useful in the islands of the Pacific where ground observation was practically impossible. Actually, the light airplane became one of the secret weapons of the war, and the light airplane was credited with improving the effectiveness of our artillery by 100 per cent.



Left to right: **Lt. Col. Claude L. Shepard, Major Richard L. Long, and Major David G. Cogswell.**

At the end of the war the use of light airplanes was extended by agreement between the Army Ground Forces and the Army Air Forces to include light airplanes also in armored-cavalry units; tank battalions; engineer battalions, infantry regiments; signal corps operations battalions; and armored, infantry, and air-borne division headquarters. Light airplanes were also included in the tables of organization and equipment of the Reserve and National Guard units.

Our Army pilots are primarily officers of their basic arm—i.e., Field Artillery, Infantry, Armored-Cavalry, Signal Corps, or Corps of Engineers, and secondarily pilots. The Air Force conducts the primary pilot training of our officers and the technical training of our airplane mechanics. The Army conducts the tactical training of our pilots in adjustment of artillery fire, performance of reconnaissance missions, and limited aerial photography.

Light aviation is in use throughout the world. Here in the United States, light airplanes are assigned to each of our divisions, schools, and boards. Light airplanes are also assigned to Army occupational forces in Japan and to our Constabulary units in Germany. Light airplanes are being used today in every possible climate and elevation from the cold of Alaska to the heat of Puerto Rico, from the mountains of Camp Carson to the plains of Kansas.

As far as types of airplanes are concerned, I believe that the Army requires three general types of light airplanes, just as the Army requires three types of light vehicles. We require two-place fixed-gear high-wing

tandem "jeep" type airplanes for our combat units; four-place, high-wing, fixed-gear "Weapons Carrier" type airplanes for our Group, Brigade, and Division Headquarters; and four-place "staff car" airplanes for our Corps, Army, Army Group, and Theater Headquarters.

We also consider that helicopters can be used to supplement and sometimes replace our light airplanes in certain situations and specialized operations because of their maneuverability and flexibility and because they do not require large landing areas or long landing strips. Helicopters have already proved to be especially useful in the Arctic, and we expect them also to be useful for aerial evacuation near the front lines. To go into more detail about our requirements for airplanes and helicopters, I should like now to introduce Major Richard L. Long, who is our representative with the United States Air Force Air Materiel Command at Wright-Patterson Air Force Base, Dayton, Ohio, who will tell you about our present aircraft procurement problems. Major Long is extremely well qualified in this field. He has been flying, repairing, maintaining, and improving our light airplanes since the beginning of World War II in North Africa, Sicily, Italy, Southern France, and Germany. Since the war, he has been actively engaged in advising the Air Force procurement, supply, and maintenance authorities concerning our light aircraft requirements. Major Long will continue with our "present" procurement problems.

PART 2
The Current Army Light Aviation Procurement Program

By

Major Richard L. Long

Development Section, Office, Chief, Army Field Forces, Air Materiel Command, Wright-Patterson Air Force Base

TO UNDERSTAND THE WAY the Army currently gets its aircraft, it is necessary to first touch upon the relationship of the United States Air Force to Army light aviation. Under the Unification Act of 1947, the old Army Air Force became a separate department. In the spirit of the act, however, the Air Force and the Army work closely together. Certain joint agreements between the two departments have been reached in order to avoid duplication. One of these agreements assigns to the Department of the Air Force the responsibility for research, development, and procurement of aircraft required by the Army for organic assignment to ground units. Beginning in Fiscal Year 1950—this coming July 1—the Department of the Army will budget for such development and reimburse the Department of the Air Force for its services.

In view of the importance of the Air Force to the Army, Army Field Forces has established a liaison section at Air Materiel Command. I am a member of this section. My job is to make known the requirements of Army Field Forces to the appropriate agencies of Air Materiel Command and to keep Army Field Forces posted on the progress of projects of interest to the Army.

Next, I should like to outline the role of Army Field Forces Board No. 1, located at Fort Bragg, N.C. In order to make certain that an item is satisfactory for Army Field Forces use prior to full-scale procurement, four testing boards have been organized. Army Field Forces Board No. 1 has, among others, an Aircraft Service Test Section. This section is made up of carefully selected Army pilots and mechanics who test all Army light aviation equipment. They conduct what is known as a "tactical suitability" test. This test involves subjecting the equipment to conditions approximating those encountered all over the world. At the conclusion of these tests, the Board submits a report of test containing its conclusions and recommendations concerning the equipment in question. These reports are reviewed by Office, Chief, Army Field Forces, and the Department of the Army before final standardization and procurement action is initiated.

Let us now follow the necessary chain of events required to fulfill the Army's requirement for organic aircraft. First of all, definite requirements must be established by the Department of the Army. The requirements are then sent to Army Field Forces Board No. 1 where military characteristics are prepared which set forth the performance, useful load, endurance, and equipment necessary in an aircraft to fill the Army's requirement. After the military characteristics have been approved by the Department of the Army, they are submitted to the Department of the Air Force, which in turn sends a directive to Air Materiel Command stating the funds available for the procurement, the number of aircraft required, and the percentage of spare parts to be procured. In the event that there are several commercially available aircraft that meet the requirements, a contract is awarded to the winner of a competitive evaluation. Such was the case in the initial procurement of L-16 and L-17 aircraft, which were the Aeronca Champion and North American Navion, respectively. Obviously, if there is only one source, a "sole source" contract is written without a competitive evaluation, as happened in the case of the YR-13 helicopter, procured from Bell Aircraft Corporation in 1947.

There are three categories that make up the overall Army aircraft procurement program. They are the handbook aircraft, off-the-shelf aircraft, and modified off-the-shelf aircraft. The handbook aircraft are those developed in accordance with *Army-Navy Specifications* and the *Air Force Handbook of Instructions for Aircraft Designers*. These aircraft are developed specifically to meet military requirements and have no civilian counterpart. An example of this type of development is the L-15, developed by Boeing to meet requirements for a two-place tandem observation airplane. Another ex-

ample is the Consolidated Vultee L-13 airplane, developed to meet the requirements of the Air Force for its liaison squadrons.

The off-the-shelf category refers to aircraft that are commercially available and for the most part meet an interim aircraft requirement. In effect, such a procurement consists of buying commercial airplanes and painting on the military insignia in lieu of the NC numbers. Examples of recent off-the-shelf procurements include the L-16 and the original L-17 North American aircraft.

The modified off-the-shelf category consists of aircraft that are basically commercially available airplanes that have been modified to make them more suitable for military requirements. Such modifications usually consist of improved instrumentation; improved radio; and, insofar as possible, the use of standard Army-Navy hoses, fittings, and equipment. An example of this procurement is the Ryan L-17B airplane.

The procurement of handbook aircraft offers many distinct advantages, such as standard hoses, fittings, and items of equipment that are readily available from Air Force supply sources; complete handbooks, technical data, and drawings; complete flight test and static test data; provisions for military loads; 24-volt electrical systems; improved maintenance provisions; and better quality control by the use of the Air Force inspection system. The main disadvantage of handbook aircraft is the high cost of development and subsequent high unit cost in production due to limited requirements. For example, the cost of handbook liaison airplane in quantity production will vary from $30,000 to $40,000 compared to approximately $2,500 for a commercial off-the-shelf airplane. Another disadvantage is that most items of equipment used in handbook aircraft, by virtue of interchangeability in larger Air Force aircraft, impose a serious weight penalty. This weight penalty can amount to 100 to 150 lbs., which seriously reduces the performance of an airplane weighing only 1,000 to 2,000 lbs.

On the other hand, commercial off-the-shelf aircraft use instruments, radios, and other items of equipment constructed to standards not so exacting and therefore not so dependable as Army-Navy standards. The maintenance and supply of these items is further complicated by the lack of complete technical data, drawings, and overhaul instructions, since they are not a common item to the Air Force. One of the most important shortcomings of off-the-shelf aircraft procured on the basis of Civil Aeronautics Administration type and production certification has been the restricted useful load. When such items as parachute, tactical radios, and other military equipment are carried in the airplane, the allowable gross weight is exceeded by 100 to 150 lbs. This further reduces the load limit factors that are initially marginal for military operations. Another disadvantage of commercial off-the-shelf procurement has been the relatively poor quality production control. This lack of quality control has been reflected not only in the basic air frame but also in the engines and other aircraft equipment. This can be corrected only by source inspection at the manufacturers plant to ensure conformity with the appropriate Air Force or Civil Aeronautics Administration requirements.

Because of the limited funds available, the Army's peacetime requirements are scaled to maximum economy measures. Therefore, it has been essential that adequate equipment be procured at a minimum of cost. It has been impossible to obtain sufficient funds to equip the peacetime Army with handbook aircraft. Such a situation would result whereby an organization authorized 20 aircraft would be provided only two handbook aircraft. This for the most part would be a duplication of the prewar "broomstick and stovepipe" Army.

Our experience using off-the-shelf equipment has been sufficiently satisfactory to make us want more. As Colonel Shepard said in the previous talk, we used the Piper Cub or L-4 all over the world in the last war. We also used the Taylorcraft L-2 and the Aeronca L-3 in the Zone of Interior. These planes did a grand job. Our more recently procured Aeronca L-16 and Ryan L-17 airplanes have also done very well. However, we feel that in the case of two-place airplanes, progress has not been rapid. Basically, the present-day two-place tandem airplane is an off-shoot of the old Taylor Cub designed 15 years ago.

The unsatisfactory reports that come into Air Materiel Command give us good indications of what the current weaknesses are. We need better and more efficient power plants. Flotation must be increased so that the airplanes can take off in mud and sand. There is an urgent requirement for ease of maintenance features, such as self-locking drain fittings, quick disconnects, ready access to engine compartments and fuel and oil refueling points, improved ground-handling characteristics, and provisions for quick disassembly and changes of major assemblies. In particular, there is an extremely urgent requirement for more standardization within the commercial aircraft accessory industry. Engine manufacturers must get together with the starter and generator people, so that every time you put on a different starter, magneto you do not have to build a new crankcase.

As we evaluate our aircraft, we look for the above-mentioned features. We notice the thought that has gone into enabling a mechanic to change the spark plugs quickly and without having to be double-jointed. We notice whether or not you have to strip the cowl off to check the oil. Can you refuel the airplane without a ladder? If you knock the gear off, do you have to send the fuselage back to the factory? I am glad to state that there has been much improvement evidenced in this respect in the aircraft we have inspected recently. We hope it will continue.

May I now introduce Major Cogswell, from the Development Section of Army Field Forces, who will give you his ideas on how the Army may be able to help you get those improved airplanes I have described.

PART 3
Future Program

By
Major David G. Cogswell
Air Division, Development Section, Office, Chief, Army Field Force, Fort Monroe

I AM GOING TO TALK about the future. Therefore, before I get myself too involved, I must make it clear that I express only my own personal views and *not* the official Department of the Army policy. There are two good reasons for this. One is that the Department of the Army policy concerning development of light aircraft has not been officially set forth as yet; the other reason is that nobody can predict what money Congress will make available to the Army for its light aviation development. However, my military assignment pertains to research and development of Army light aviation to meet Army requirements, and I think what I have to say is reasonable, logical, and of interest to you.

I have just stated that nobody can predict what Congress will do in the future; now I must qualify that statement. I think we can safely predict what Congress will not do—and that is not give us all the money we think we need for our light aviation business. Therefore I think that the Army will have to continue its practice of meeting its peacetime training requirements, and for the initial phases of any combat, with off-the-shelf commercial aircraft modified to meet our particular requirements.

If the Army is going to use off-the-shelf aircraft, it must get the best that are available to meet its needs. This can be determined only by careful evaluation of existing aircraft.

There are essentially two ways for conducting a good evaluation—one by going to the individual manufacturers plants and inspecting the aircraft and one by inviting the manufacturers to one central point and inspecting the aircraft along side of each other. The latter system is much easier and better for the Army. It is not feasible in all cases. We cannot expect helicopters to fly 2,000 miles for such an evaluation.

If our evaluation is to be held, it should be held periodically at regular intervals. This would give the manufacturers time to prepare themselves. If possible, it should be held in the early spring, so that the manufacturers can utilize the slack winter months to get ready. The requirements of the Army must be made known so that the manufacturers can try to meet them.

If the evaluation is going to be a success, there must be manufacturers who are willing to go to the expense of having their products evaluated. Therefore it seems to me the Army must offer some inducement. This can be done in two ways. First, the Army should purchase two or three of each of the winning models and service-test them extensively in the field to determine just how adequately they do fill the Army's requirements. Secondly, I think the Army should set the life of its commercial aircraft at 3 years. It should then procure roughly one-third of its total aircraft requirements each year somewhat as follows: first year, Regular Army units in the Zone of Interior; second year, Regular Army units overseas; and third year, National Guard and Reserve Requirements. If this were done, then the winning yearly models, after being extensively service-tested as outlined before, would be procured in quantity. By geographical separation, the variety problem encountered in parts could be lessened.

I think, and hope, this would be sufficient inducement for commercial manufacturers to compete for Army business.

It is important that the Army and commercial personal aircraft manufacturers cooperate since each needs the other. The Army would be in a bad way if it could not procure the relatively inexpensive commercial product and, what is more important, if the great potential output of these manufacturers were not available in the event of sudden hostilities. I also believe the commercial manufacturers would appreciate the added stimulus of relatively large military sales.

But how can the Army help the commercial manufacturers? It cannot hope to buy enough aircraft each year to support the whole industry or even one company. I do think it can help by developing the more expensive components. You have just heard Mr. Hage's talk on the Boeing gas turbine. All of you would like to have that power plant available to put in your aircraft. Yet who is going to pay for its development? I am afraid its evolution will be extremely slow unless the Army takes up the development ball and helps carry it. So, I think the Army should focus its relatively meager funds on component development and make such development available to the industry. I have in mind such developments as better power plants; lightweight starters, generators, and batteries; adjustable or constant-speed propellers; high lift and glide path control devices; better radios; and similar items.

The commercial manufacturers can help the Army in many ways. Essentially, the Army wants four things, all of which are equally important—first, dependability under all conditions of operation; second, good visibility particularly forward and downward; third, good safe short field performance; and, fourth, sufficient gross weight and space to carry our loads. I think these features are also desired by the commercial market. Therefore, wherever economically possible, I should like to see you engineer into your products those details the Army wants and looks for.

Everything in the military services has to be tied up in red tape. The Army light aviation business is no exception, as you so well know. The exact details of what the Army wants in its aircraft are contained in what is known as "military characteristics." Unfortunately, these characteristics contain restricted data, and therefore the detailed characteristics are not available to the industry as a whole. I hope that in the future the Army will be able to come up with unclassified military characteristics that can be circulated to the in-

dustry. Certainly this will be essential if the Army is to conduct the evaluation of personal aircraft of which I spoke earlier.

If it is possible to circulate these military characteristics, most of you will be rudely awakened to find that nobody has a commercial product available today which embodies all of these characteristics. Frankly, we do not expect that anybody can meet them today. We always want more performance, for the ideal is the vertical landing and take-off aircraft. If helicopters were not so expensive and complicated, we would perhaps use them to replace fixed-wing aircraft. But fundwise, we just do not have the money. These military characteristics present more of a goal for which we should like you to shoot. We would hope that, as you bring out new models for your commercial market, you would take these military characteristics as a guide for incorporating as many of our features as possible in your new models.

The Army is anxious to help the commercial personal aircraft industry in any way possible. It is for that reason that Colonel Shepard, Major Long, and I are here today. The purpose of our talks has been to familiarize you who will be designing the airplanes of tomorrow with the Army problems so that you can help us and our successors in the future.

There are many things that we have not covered today about which you will have questions. If we do not answer them in the brief time we have here, please drop us a line. Correspondence may be addressed as follows: Chief, Army Field Forces, Fort Monroe, Va., Attention Air Division, Development Section. This happens to be my address, since both Colonel Shepard and Major Long are going to The Artillery School this June and will not be able to answer your questions. However, I will route your letters to their successors if your questions do not pertain to my particular field.

We are anxious to see your new prototypes. We are unable to tour the countryside too extensively; so, if convenient, we should appreciate your coming around to see us. By "us" I mean the Aircraft Service Test Section, Army Field Forces Board No. 1, Fort Bragg, N.C.; the Department of Air Training, The Artillery School, Fort Sill, Okla., and various interested officers of the Department of the Army General Staff, the National Guard Bureau in the Pentagon Building, Major Long at Air Materiel Command at Wright-Patterson Air Force Base, and Colonel Shepard and myself at Fort Monroe.

Dr. C. C. Furnas on "Research for Aircraft Safety"

(*Continued from page 21*)

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[12] *American Aviation Daily*, January 14, 1949.

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The Boeing 200-Hp. Gas Turbine and the Light Airplane

S. D. HAGE*

Boeing Airplane Company

THE DEVELOPMENT OF this small gas turbine by the Boeing Airplane Company is an outgrowth of a research program undertaken in 1943 to support the development of a turbojet-driven bomber. This program, in addition to resulting in a semideveloped engine, provided an understanding of this type of engine which promised a useful market of unknown size but *certain* existence. One of these markets is the light airplane market. The numerous advantages the gas turbine can offer will be brought out in this paper.

A small gas turbine can be a neat and simple machine. The Model 502, developed by this company, is a machine accenting simplicity. Fig. 1 is a three-quarter view from the compressor end, and Fig. 2 is a three-quarter view from the turbine end. The top half of Fig. 3 is a vertical section, and the bottom half is a horizontal outline. The engine consists of a single-stage centrifugal compressor with two outlets, two constant pressure burners, and a compressor-driving turbine. This primary stage, or hot-gas producer, has a rated speed of 36,000 r.p.m. and drives the accessories. The secondary or power output stage consists of another turbine with a rated speed of 24,000 r.p.m. and a 9.6:1 reduction gear, giving a rated output speed of 2,500 r.p.m. The speed of the primary stage is entirely regulated by the fuel flow, and the speed of the secondary stage is independently regulated by the load and can be varied from stall to runaway or maximum safe speed.

The weight of the engine without accessories is approximately 150 lbs. The power output will vary between 100 and 200 b.hp., depending on the endurance life expected. The rated specific fuel consumption will vary between 1.5 and 1.0 lbs. per b.hp.-hr., depending on the rating and the degree of component refinement possible. The engine is extremely easy and consistent to start; it can develop rated power 15 sec. after the start is initiated. It can accelerate rapidly, going from idle, which is about 10,000 r.p.m., to full speed in 5 sec. It is practically vibrationless if the rotating parts are accurately balanced; it is destructively rough if not. The basic simplicity is well illustrated by Fig. 4, which

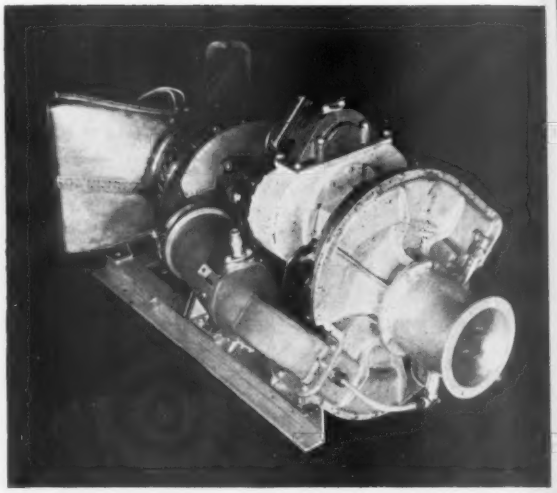

FIG. 1.

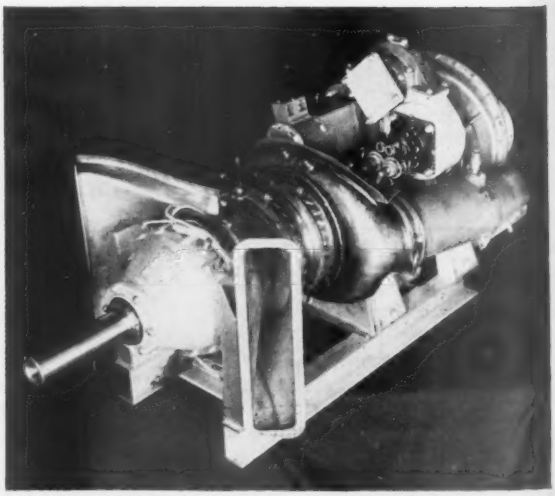

FIG. 2.

Presented at the Sixth Annual Personal Aircraft Meeting, I.A.S., Wichita, Kan., April 30, 1949.

* Chief, Propulsion Development Unit, Seattle, Wash.

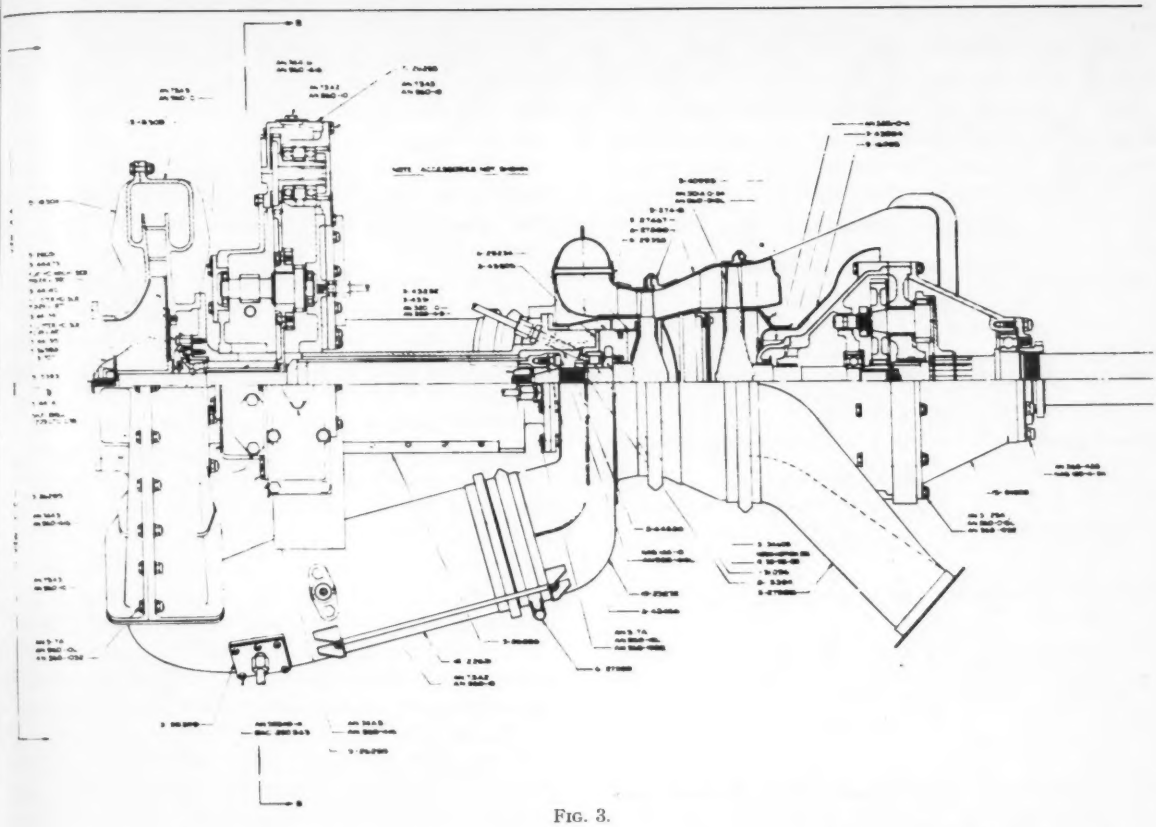

FIG. 3.

shows a comparison of the number of parts and the number of running machined fits with other engines.

Fig. 5 illustrates some of the important performance characteristics and their comparison with other engines. Two types of loads are shown by the dotted lines: a grade load representing one extreme in load type and an air friction load representing the other extreme. It will be noted that the brake horsepower curve for the Model 502 provides considerably more excess power for acceleration than the reciprocating engine, for either type of load. In addition, the gas turbine cannot be stalled. This is also shown by the torque curves. The reciprocating engine torque falls to zero at zero speed. The Model 502 stalled torque is twice the rated speed torque. The solid SFC curves are shown for maximum power at any speed. The dashed SFC curves are for an air friction or cubic load. It is interesting to consider that the best economy point for any power, in the case of the Model 502, lies on a cubic load curve. Since such a load is characteristic of most power requirements in the transportation field (land, water, and air), this type of engine is admirably suited, without any complicating load-varying devices. It should be emphasized that a gas turbine without a free power turbine is not suitable for general applications. The direct connected machine has a maximum power characteristic close to the air friction load curve and will stall if loaded below about 40 per cent speed.

	BOEING 502	LYCOMING O-435-2	GRAY 64-HN-9	WAUKESHA 6WAK
NUMBER OF PARTS IN ENGINE	175		590	
PART NUMBERS IN ENGINE	220		1400	
COMPLETE OVERHAUL PARTS LIST	20	160	210	150
NUMBER OF CLOSE TOLERANCE RUNNING FITS	16	100	135	100

STANDARDS NOT INCLUDED

FIG. 4.

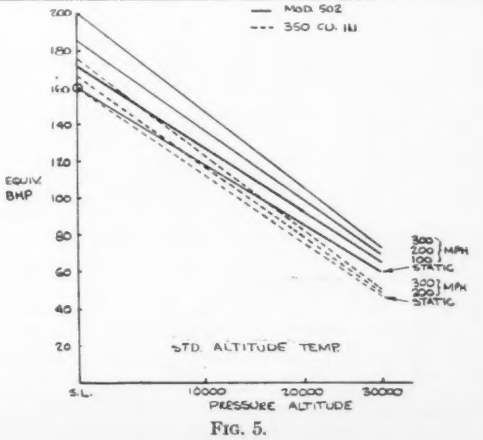

FIG. 5.

Offsetting some of the desirable features of a small gas turbine previously mentioned are some features that should be discussed. The air consumption is extremely high, and large intake and exhaust friction losses are not tolerable. The author has not yet seen a clean solution to the compressor-inlet noise problem. This silencing problem is especially difficult because of the large flow and the necessity for extremely low pressure drop. The idle fuel consumption is high, roughly one-fifth full power consumption. The development cost is high. This is primarily the result of having to solve so many new problems along with the general run of mechanical problems that plague any new piece of machinery.

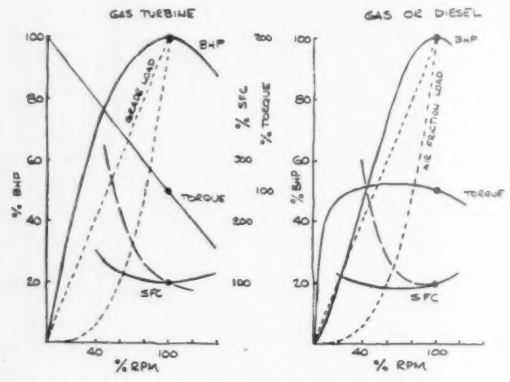

FIG. 6.

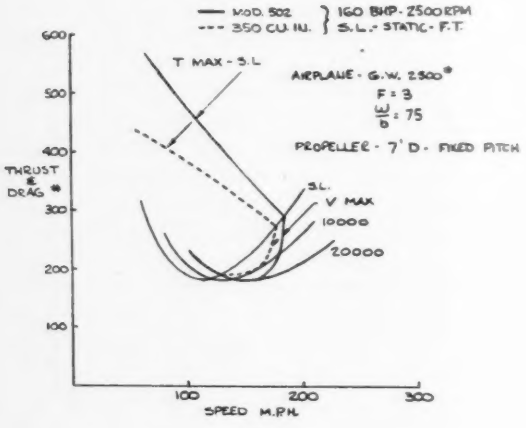

FIG. 7.

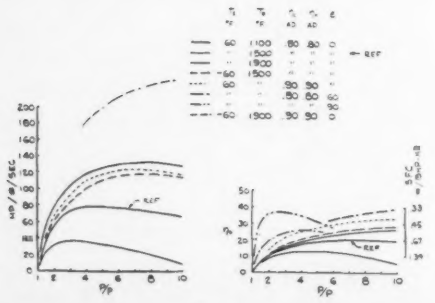

FIG. 8.

Fig. 6 shows a comparison of the Model 502 with a 350-cu.in. air-cooled aircraft engine, both rated at 160-b.hp. sea-level static. This comparison shows a reduced power loss with altitude and an increased power gain with ram for the gas turbine. The gas turbine, with minor changes in flow areas, can be tailored to vary both of these effects so as to favor a particular application. The ram effect can be increased, and the altitude loss can be reduced even more than shown, within this range of speeds and altitudes.

Fig. 7 shows a comparison of the Model 502 and a 350-cu.in. air-cooled engine in a light airplane. The gross weight has been fixed at 2,500 lbs.; the drag area, at 3 sq. ft.; the span loading, at 75 lbs. per ft.; the fixed-pitch propeller diameter, at 7 ft. The superior ram and altitude characteristics of the Model 502 result in considerably improved high-speed performance. The superior output torque characteristic of the Model 502 results in considerably increased thrust for take-off and climb. The cooling drag of the piston engine would probably increase the drag area by 0.5 sq. ft., although this has not been included. The engine weight differential is 200 lbs. in favor of the gas turbine. Estimating the cruising specific fuel consumption of the Model 502 at 1.5 lbs. per b.hp.-hr. and the piston engine at 0.6 lb. per b.hp.-hr., this 200 lbs. would be eaten up by fuel in about 3 hours.

Production costs are unknown, but it seems most reasonable that they will be less per horsepower than reciprocating engines. Available information on one of the large American turbojet engines indicates an engine cost of about $11 per lb. This is less than the cost of aircraft piston engines designed to the same weight and life standards. In addition, the prospects for future improvement through development are excellent, both as to fuel consumption and power-weight ratio. Component refinement will pay off in both. The use of regenerative heat exchangers will pay off well in fuel consumption at the expense of power weight ratio.

Fig. 8 shows a plot of hp. per lb. air per sec. (primarily affecting machine size) and thermal efficiency (η_0) against cycle pressure ratio (P/P) for various inlet temperatures (T_i), nozzle box temperatures (T_φ), compressor efficiencies (η_c), turbine efficiencies (η_T), and regenerator effectiveness (ϵ). It can readily be seen that the upper practical limits for this type of engine are extremely high indeed and are worth reaching for.

It is also apparent that the advantages shown for the current engine in a light airplane will be considerably increased by minor improvements in component efficiency and pressure ratio.

I.A.S. Briefs

Summaries of current papers accepted for publication or presentation at I.A.S. Meetings

Interference Between Wing and Body at Supersonic Speeds—Note on Wind-Tunnel Results and Addendum to Calculations

By

Carlo Ferrari

Cornell Aeronautical Laboratory, Inc.

A correction is made to the numerical example worked out in a previous paper for the pressure distribution on a rectangular wing operating in the upwash from a pointed inclined body of revolution in a supersonic stream. Wind-tunnel results confirm the amended calculated pressures and bring to light the drastic falling off of lift in the wing-body juncture.

A Unit Solution for the Load Distribution of a Nonrigid Wing by Matrix Methods

By

Samuel Pines

Republic Aviation Corporation

The use of matrices facilitates the solution of the spanwise lift distribution for the case of a flexible wing for all conditions of load factor, incompressible air speed, aileron and flap deflection, and roll in a convenient form within the range of linear variation of section lift with angle of attack. The method yields the critical values of wing divergence speed, aileron reversal speed, and wing-aileron divergence speed, without additional computational effort, for the conventional wing and may be adapted to the sweptback wing.

Relations Between the Characteristics of a Wing and Its Reverse in Supersonic Flow

By

A. H. Flax

Cornell Aeronautical Laboratory, Inc.

On the basis of linearized supersonic aerodynamic theory, certain relations between the aerodynamic characteristics of a given wing and another wing having the same plan form but with leading and trailing edges interchanged are derived. The latter wing is called the reverse of the first. Only the case of "purely" supersonic flow (Mach wave always behind wing leading edge) is considered. It is shown that in such cases the slope of the lift curve, the drag due to lift, the wave drag at zero lift, the damping in roll, and the damping in pitch are the same for any given wing and its reverse. In addition, a simple relation between the static pitching moment derivative of a wing and the lift derivative due to pitching of its reverse is obtained.

Please do not order Preprints of these papers at this time.

See page 35 for Preprints that are immediately available.

The Stress Analysis of Arbitrarily Shaped Wing Structures with Shear Stressed Skin and Walls

By

Dr. H. F. Michielsen

Fokker Aircraft Factories

The internal load of a statically indeterminate wing structure can be decomposed into a basic system and a number of self-equilibrating load systems. Each of the latter involves two or three rib segments, three or two spar segments, as well as the two upper and two lower panels bounded by them. The calculation of the forces in these statically determinate systems is presented. The fundamental problem is the calculation of the multiplying factors, the statically indeterminate quantities, of the self-equilibrating systems.

With the aid of Castigliano's Theorem of Least Work, the redundant quantities are found as the roots of a system of linear equations. A suitable method of solution, first suggested by Gauss, is presented. The coefficients in these systems of linear equations are obtained as the integrals of the products of two self-equilibrating systems or of one such a system and the basic load system. The loads can be decomposed into one- to three-unit loads, depending upon the structural element, and the integration need be carried out only for these unit loads.

The coefficients of the equations are then obtained through a summation of the integrals of the products of the unit loads, after each integral is multiplied by a suitable factor. The main problem is, therefore, the systematic determination of these multiplying factors. Details are given in a number of tables.

A special section deals with the evaluation of the integrals of the products of the unit loads. However, this part of the calculations is somewhat uncertain because of the unreliability of some of the assumptions.

A concluding remark indicates the possibility of an extension of the procedure into the plastic region.

A Numerical Procedure for the Stress Analysis of Stiffened Shells

By

John E. Duberg

Langley Aeronautical Laboratory, N.A.C.A.

A numerical procedure is developed for the stress analysis of stiffened shells of arbitrary cross section. The procedure is based on the usual assumption of shell stress analysis—that the shape of the cross section is maintained by stiff bulkheads. The method is general enough to include the effects of cutouts, as well as the secondary effects due to restrained warping usually referred to as shear lag when the shell is loaded primarily in bending, and bending stresses due to torsion when the shell is loaded primarily in torsion.

The quantities determined directly are the spanwise distribution of the axial displacements of the shell cross sections and the relative rotations and displacements of the shell cross sections. The numerical equations defining these qualities are solved by simple iteration. In order to obtain practical convergence of the process, it is necessary to refer displacements and loads to a set of axes in the cross section, which are defined as the principal axes for shear, and to resort to the occasional use of a special cycle in the iteration process, which in effect removes all displacements associated with planar distributions of axial displacement of the shell cross section.

The details of the application of the procedure to a simple problem are shown in some detail, and the results obtained from a more complex problem are summarized.

A New High-Performance Engine Indicator of the Strain-Gage Type

By

C. S. Draper and Y. T. Li

Massachusetts Institute of Technology

Pressure changes in the working fluid largely determine the performance of heat engines. For this reason, accurate pressure indications are of primary importance for studies of engine operation. Pressure indicators have been in use for many years, but performance defects have restricted their value even for laboratory and test-stand work. The operating limitations have been due to the fact that available pressure receivers have been sensitive not only to pressure but also to temperature, to mechanical strains due to mounting effects, and to mechanical vibrations in the walls of the pressure chamber. It is the purpose of this paper to describe the features of a new pressure receiver using a high-flexibility catenary-type diaphragm and a temperature-compensating wire-wound strain gage to give satisfactory pressure-measuring characteristics with greatly reduced response to temperature and extraneous mechanical effects.

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178 The Sperry Zero Reader—S. Kellogg, Engineering Department Head for Flight Instruments, and C. F. Fragola, Engineering Section Head for Electronic Development, Sperry Gyroscope Company.

179 Convertible Aircraft—R. S. Barnaby, Chief, S. M. Berkowitz, Project Leader, and W. H. Colcord, Assistant Chief, Aeronautics Section, The Franklin Institute.

180 Present Status of Research on Boundary-Layer Control—A. E. von Doenhoff and L. K. Loftin, Full Scale Research Division, Langley Aeronautical Laboratory, N.A.C.A.

181 Measurements In Flight of Spanwise Wing Loading—W Lavern Howland, Flight Service Engineering Supervisor, Lockheed Aircraft Corporation.

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186 Influence of Acceleration on Aerodynamic Characteristics of Thin Wings in Supersonic and Transonic Flight—C. S. Gardner, Research Associate, and H. F. Ludloff, Associate Professor, New York University.

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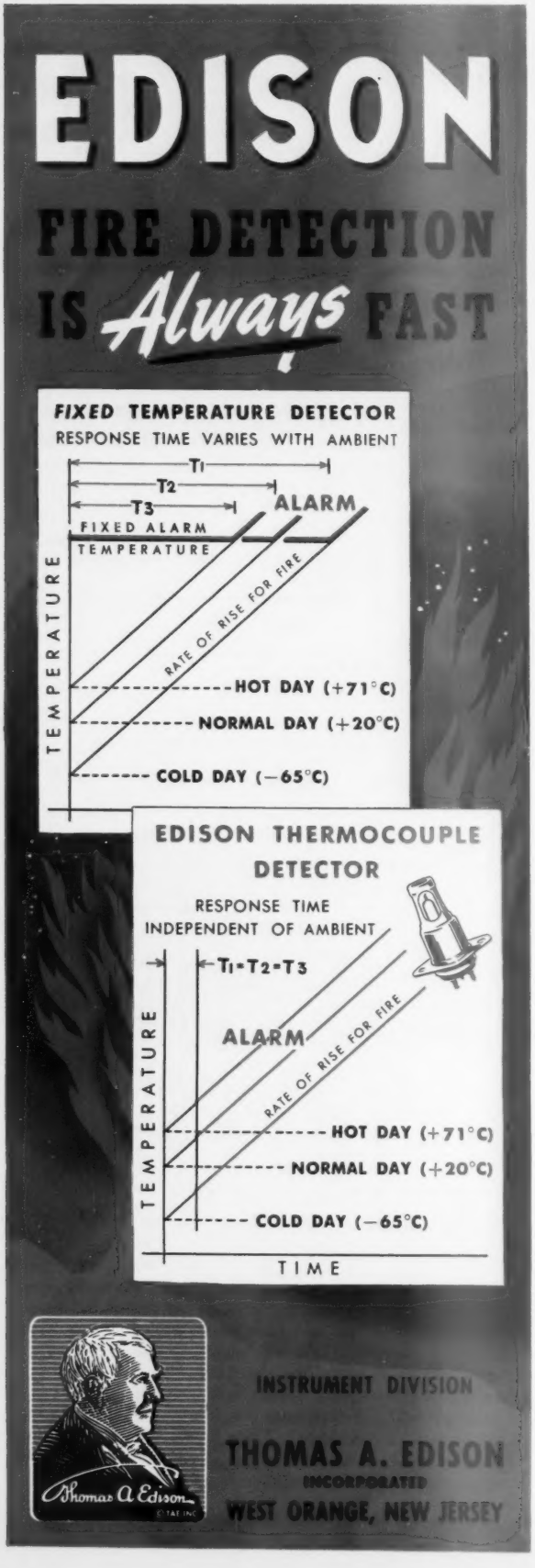

Aerodynamics (2)

BOUNDARY LAYER

Note on Empirical Relations for a Turbulent Boundary Laye A. Fage and W. G. Raymer. *Gt. Brit., Aeronautical Researc Council, Reports and Memoranda No. 2255*, March 6, 1946. pp., figs. 4 references. British Information Services, Ne York. $0.70.

A comparison of the results given by the von Doenhoff-Tetervi and the Garner methods for the prediction of the growth of turbulent boundary layer. Each method is derived on the as sumption that the shape of the velocity profile of a turbulen boundary layer can be specified by the value of a single parameter the ratio of the displaced thickness to the momentum thickness The Garner method makes use of the Falkner power relation fo the intensity of skin friction on a flat plate in a uniform stream whereas the von Doenhoff-Tetervin method uses the Squire-Young logarithmic relation. Comparisons show that they give noteworthy different results. It has yet to be proved that the velocity profile of a turbulent boundary layer can be specified by this single parameter.

An Integral Relationship for Boundary Layer Flow. L. G. Whitehead. *Aircraft Engineering*, Vol. 21, No. 239, January, 1949, pp. 14–16, figs. 11 references.

To be used simultaneously with, or to replace, the von Kármán momentum integral to which it is similar in form but different in the values of the numerical coefficients. When applied simultaneously with momentum integral it will give a considerable increase in accuracy for retarded flows where approximate solutions are frequently in error.

Flight and Tunnel Test Research on Boundary-Layer Control. H. B. Dickinson. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 243–251, illus., diagrs., figs. 3 references.

Investigation of slot and duct design by the Lockheed Aircraft Corporation showed that, without flow across the slot, internal losses of a slot of 1 per cent chord width could be reduced to 10 per cent of the dynamic pressure at the throat. Thus the blower power required to overcome the internal drag of the system would be negligible from an airplane performance standpoint. In tests on an NACA 66 airfoil in the Lockheed wind tunnel, the modifications of the ducting that were required to obtain a uniform suction over the span increased the duct losses so as to offset any drag reduction obtained. In full-scale flight tests, boundary-layer control was applied to an envelope installed outboard of the booms of a P-38 airplane. The modification of duct design necessary to obtain a uniform flow coefficient over the span of the envelope and the structural limitations imposed by the aircraft wing made test results meaningless except to show, by the high duct losses incurred, the magnitude of the internal flow problem. Although no net drag decrease was obtained in the wind-tunnel and flight tests, the large wake-drag reductions that were measured indicated that suction boundary-layer control with efficient ducting could effectively reduce airplane drag.

Experiments on a Laminar Suction Airfoil of 17 Per Cent Thickness. W. Pfenninger. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 227–236, illus., diagrs., figs. 32 references.

Boundary-layer suction experiments conducted in the 7- by 10-ft. wind tunnel at the Institute for Aerodynamics, Zurich. The suction quantities required to keep the boundary layer completely laminar on both sides of an airfoil were small for a considerable range of lift coefficients. The profile drag was reduced one-half, the range of lift coefficient values with low drag coefficients was more than doubled, and an optimum gliding angle of $^1/_{200}$ was obtained. With moderate deflections of a small trailing-edge flap a favorable envelope of polars, as well as an optimum gliding angle of the airfoil of $^1/_{250}$, was reached.

FLUID MECHANICS & AERODYNAMIC THEORY

On Compressibility Corrections for Subsonic Flow Over Bodies of Revolution. Eric Reissner. *U.S., N.A.C.A., Technical Note No. 1815*, February, 1949. 9 pp., figs. 5 references.

A study of the subsonic flow past an infinitely long corrugated circular cylinder to show the relation between two-dimensional and axisymmetrical flow. A solution is obtained which contains, as limiting cases, both the Prandtl-Glauert correction for two-dimensional flow and the Göthert correction for flow past slender bodies of revolution. Included are velocity correction formulas

for a cylinder with a single bump and for a corrugated cylinder in the presence of walls.

The Force of Impact on a Sphere Striking a Water Surface: Approximation by the Flow About a Lens. Max Shiffman, Donald C. Spencer, and others. *New York University, Applied Mathematics Group, Report No. 105 (National Defense Research Committee, Applied Mathematics Panel, Report No. 42.1R,* February, 1945. 52 pp., figs. 6 references.

An explicit mathematical investigation of the impact forces acting on a spherically nosed projectile, when it enters water vertically, in order to establish strength requirements that will preclude the damage of instruments and control mechanisms carried by missiles. A dimensionless impact drag coefficient is plotted as a function of the depth of penetration. Its maximum value, 0.95, occurs when the lowest point of the spherical nose is about one-quarter of a radius past the original level of the water surface. Calculations are based on the flow about a lens which is determined by a method used by A. Sommerfeld in the theory of diffraction of light.

Surface Waves in Water of Variable Depth. J. J. Stoker, H. Lewy, and others. *New York University, Institute for Mathematics and Mechanics, AMG-NYU No. 153,* August, 1946. 107 pp., figs. 13 references. A comparison of approximate and exact linear solutions for progressing waves over a uniformly sloping bottom.

On the Application of Viscosity Data to the Determination of the Shape of Protein Molecules in Solution. J. M. Burgers. (*Delft, Technische Hoogeschool, Laboratorium voor Aero-en Hydrodynamica, Mededeeling No. 38.*) *Nederlandsche Akademie van Wetenschappen, Verhandelingen,* Vol. 43, Nos. 3–5, 1940. 28 pp., figs. 15 references. (Reprint.) (In English.)

Approximate calculations of the sedimentation velocity of protein molecules and their contribution to the effective viscosity of a liquid in shearing motion. The velocity fields set up by the motion of molecules are considered to be systems of rigidly connected spheres in linear, square, or cubic configuration.

INTERNAL FLOW

Generalized Charts for Determination of Pressure Drop of a High-Speed Compressible Fluid in Heat-Exchanger Passages. Michael F. Valerino. *Journal of the Aeronautical Sciences,* Vol. 16, No. 5, May, 1949, pp. 311–315, fig. 3 references.

An analysis of the compressible-flow variations occurring in heat-exchanger passages. In order to avoid tedious numerical integration for each set of conditions in the heat-exchanger, the flow and heating characteristics are described for which specific flow passages can be treated as segments of a generalized flow system. The graphical representation of the flow variations in the generalized flow system can then be used as working charts to determine directly the pressure changes occurring in any given flow passage for any given flow and heating condition. Such working charts are constructed for the case of airflow in a smooth-wall passage heated at constant wall temperature under turbulent fluid-flow conditions for rates of flow from 0.15 to 1.0 (choke) Mach and for wall temperature to air temperature ratios from 5.0 to 1.1. The effect on the heat-exchanger flow process of high-temperature differential is taken into account as shown by the good agreement obtained between the experimental and the chart pressure-drop values for passage-wall average temperatures as high as 1,700°R. (experimental limit) and for flow Mach Numbers at the passage exit, ranging from 0.32 to 1.00 (choke).

Readers' Forum: Induced Deflection Angle in Cascades. W. R. Hawthorne. *Journal of the Aeronautical Sciences,* Vol. 16, No. 4, April, 1949, p. 252, figs.

An analysis of a flow pattern, similar to that treated in "The Theoretical Induced Deflection Angle in Cascades Having Wall Boundary Layers," by George F. Hausmann (JOURNAL OF THE AERONAUTICAL SCIENCES, Vol. 15, No. 11, p. 686, November, 1948), leads to the conclusion that the deflection in the cascade of finite span is larger than in the cascade of infinite span. It is doubtful whether this method of representing the flow is adequate, because it does not account for all the boundary-layer effects.

Conductance of Bends and Concentric Tubes of a Vacuum System. E. V. Sherriff. *Journal of Scientific Instruments,* Vol. 26, No. 2, February, 1949, pp. 43–45, figs. 6 references.

PERFORMANCE

Summary of Measurements in Langley Full-Scale Tunnel of Maximum Lift Coefficients and Stalling Characteristics of Airplanes. Harold H. Sweberg and Richard C. Dingeldein. *U.S., N.A.C.A., Report No. 829,* 1945. 36 pp., illus., diagrs., figs. 15 references. U.S. Govt. Printing Office, Washington. $0.25.

Effects on maximum lift and stall of wing geometry, fuselages and nacelles, propeller slipstream, surface roughness, and wing leading-edge appendages such as ducts, armaments, tip slats and air-speed heads. Results indicated that large improvements in the maximum lift and stall characteristics of airplanes can be obtained by careful attention to detail design. A comparison of full-scale tunnel and flight measurements of maximum lift of an airplane showed that satisfactory agreement may be obtained if the comparison is made under similar test conditions, such as Reynolds Number, slipstream, and time rate of change of angle of attack.

Practical Aerodynamics in France. *The Aeroplane,* Vol. 76, No. 1967, February 18, 1949, pp. 187–189, illus., diagr. Wind-tunnel and flight testing of low-speed aerodynamics with the Breguet 460, the 730, the 482, the Breguet G.II.E Gyroplane, and the Breguet L23 laminar-flow airfoil fitted to the wing of an SUC 10 "Courlis."

WINGS & AIRFOILS

Theoretical Lift and Drag of Thin Triangular Wings at Supersonic Speeds. Clinton E. Brown. *U.S., N.A.C.A., Report No. 839,* 1946. 8 pp., figs. 7 references. U.S. Govt. Printing Office, Washington. $0.15.

The flow about a triangular flat plate is obtained from the potential function of a line of doublets by the elementary supersonic source solution of the linearized equation of motion and the surface distribution of these doublet lines. By this method, the slope of the lift curve of point-forward triangular wings at supersonic speeds is found to be a function of the ratio of the tangent of the apex angle to the tangent of the Mach angle. As the leading edge approaches and passes outside the Mach cone, the lift approaches and becomes equal to that of a two-dimensional supersonic airfoil at the same Mach Number. When the leading edges are not too far behind the Mach cone, the lift-drag ratio of swept wings should be higher than that of unswept wings. When the leading edge is well behind the Mach cone, the drag coefficient attributable to the lift is close to that of elliptically loaded wings of the same aspect ratio in subsonic flight. When the leading edges lie outside the Mach cone, however, the resultant force on the wings acts normal to the surface to produce an induced drag equal to the lift multiplied by the angle of attack.

Triangular Wings Cambered and Twisted to Support Specified Distributions of Lift at Supersonic Speeds. Barrett S. Baldwin, Jr. *U.S., N.A.C.A., Technical Note No. 1816,* February, 1949. 30 pp., figs. 5 references.

Application of linearized supersonic flow theory to the calculation of the camber and twist required for various lift distributions on a triangular wing with leading edges behind the Mach cone. Plots of the cambered surfaces, the corresponding lift distributions, and values of the theoretical drag coefficients are presented for several specific examples that were chosen to avoid the singularities in lift distribution or camber which appear in previously given solutions and which may be used for practical applications, since they avoid large pressure peaks and extreme angles of twist.

A Study of Stall Phenomena on a 45° Swept-Forward Wing. Gerald M. McCormack and Woodrow L. Cook. *U.S., N.A.C.A., Technical Note No. 1797,* January, 1949. 32 pp., illus., figs. 3 references.

Three-component force data, pressure distribution, tuft studies, and boundary-layer measurements obtained on a large-scale wing in the Ames 40- by 80-ft. wind tunnel to enable a detailed correlation between separation phenomena, and the longitudinal characteristics of the sweptforward wing. In the moderate lift range, the occurrence of turbulent separation caused a chordwise redistribution of load over the inboard sections. This, in turn, caused increases in drag and a rearward shift of aerodynamic center but caused no loss of lift. In the high lift range, the occurrence of leading-edge separation caused a loss of section lift that occurred first over the inboard sections and traveled outward as the angle of attack was increased. This caused large increases in drag, a decreased lift-curve slope, and,

because of the changes in spanwise loading, an extremely large forward shift of aerodynamic center. In order to improve the longitudinal characteristics of the sweptforward wing, both forms of separation must be postponed.

Measurements of Force Coefficients on the Aerofoils EC 1240 and EC 1240/0640 in the High Speed Tunnel at the National Physical Laboratory. Staff of the N.P.L. High-Speed Tunnel. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2246*, September, 1940. 9 pp., figs. British Information Services, New York. $0.70.

Readers' Forum: Transform and Variational Methods in Supersonic Aerodynamics. John W. Miles. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 252, 253. 7 references. The use of transforms with respect to both streamwise and spanwise coordinates.

Air Transportation (41)

Records and Transports. R. H. Mayo. *Flight*, Vol. 55, No. 2096, February 24, 1949, pp. 234, 235, figs. (Extended summary of a paper.) Analysis of the speed, distance, and altitude records to show their relation to air-transport cruising speeds and aircraft design.

Aviation Analysis; A Personal Expression of Opinion on the Effect of Nationalization of Civil Aviation in Great Britain and a Brief Review of Those Events Which Led to Government Control of the Airlines. J. W. S. Brancker. *Flight*, Vol. 55, No. 2090, January 13, 1949, pp. 54, 55. (Summary of a paper.)

After Victory What? John H. Stewart. *Air Transportation*, Vol. 14, No. 3, March, 1949, pp. 13–15.

The economy of collective consignment of freight shipments. The freight forwarder functions as an intermediary between the shipper and the carrier. The author offers two types of complete indirect transportation service from point of origin to point of destination each of which includes pickup and delivery, insurance, interline transfer, routing, billing, and tracing serivce: a pure freight service and an express service. The former is routine delivery; the latter, the most expeditious handling of separate packages.

The Cargoplane Must Go Through; Why the Air Shipper Has a Stake in the Perfection of All-Weather Flying. John M. Sitton. *Air Transportation*, Vol. 14, No. 3, March, 1949, pp. 8–10, 31, illus.

Markets for Airborne Seafoods. II—Consumption of Fresh Fish. Spencer A. Larsen, William Reitz, and Katherine K. Burgun. *Air Transportation*, Vol. 14, No. 3, March, 1949, pp. 16, 17, 26, 27, illus.

Topdressing by Air. *New Zealand Flying*, Vol. 2, No. 17, January 15, 1949, p. 6, illus.

Let Us Spray—Intelligently. George Haddaway. *Southern Flight*, Vol. 31, No. 2, February, 1949, pp. 14, 15, 39, 40, illus. The need for the dissemination of scientific information and an interchange of operating standards and procedures in order to obtain acceptance of aircraft for crop dusting and spraying.

Berlin Airlift Revolutionizing Air-Cargo Operations of Future. William J. Perkinson. *The Martin Star*, February, 1949, p. 14.

British Civil Aviation; Ministerial Statement. *Modern Transport*, Vol. 60, No. 1559, February 12, 1949, p. 11.

Antarctic Air Survey (Graham Land). *Flight*, Vol. 55, No. 2094, February 10, 1949, p. 163, illus.

Winged Cargo. W. H. Burbury. *Indian Skyways*, Vol. 3, No. 1, January, 1949, pp. 28, 29. Considerations for establishing a purely freight-carrying scheduled service linking Bombay, Calcutta, Delhi, and Madras coordinating at Nagpur which would attract freight in small lots.

West African Airways. *The Aeroplane*, Vol. 76, No. 1967, February 18, 1949, pp. 190–192, illus.

West African Airways. *De Havilland Gazette*, No. 49, February, 1949, pp. 5–16, illus.

Airplane Design & Description (10)

The End of an Age. I. Roger Tennant. *The Aeroplane*, Vol. 76, No. 1963, January 21, 1949, pp. 75, 76, illus. Changes that have taken place in the conventional, subsonic airscrew monoplane from 1930 to 1940.

AIRPLANE DESCRIPTIONS

Personal Planes; Photos, Facts, Figures—(Thirty) U.S. Private Planes 1949. *Skyways*, Vol. 8, No. 4, April, 1949, pp. 33–41, illus.

Argentina's Industry. William Green. *Flight*, Vol. 55, No. 2095, February 17, 1949, pp. 198, 199, 203, illus.

Aircraft of domestic design and manufacture produced since the Fabrica Militar de Aviones at Cordoba was established. At present the Institute Aerotecnico plans the construction of a prototype four-engined transport, work to commence this year and series production in 1951; a twin-engined transport; and a modern basic trainer. Includes a listing of recent purchases of trainers, fighters, bombers, and transports.

Flight by Turbine; A Firsthand Report on Flight Experience With Jets and Prop Turbines. R. G. Worcester. *Canadian Aviation*, Vol. 22, No. 3, March, 1949, pp. 18, 19, 50, 51, illus.

Able Mabel (Martin Mauler AM-1); Martin Mauler Carries Three Torpedoes and R.P.s. *Flight*, Vol. 55, No. 2093, February 3, 1949, p. 144, illus.

Navy "Skyrocket (Douglas D-558-2) Tested With JATO Over California's Mojave Desert. *U.S., Central Air Documents Office (Navy-Air Force), Technical Data Digest* Vol. 14, No. 5, March 1, 1949, pp. 13, 14, illus.

Improvements on the F-84 (Republic Thunderjet). *Plane Facts*, Vol. 6, No. 2, February, 1949, pp. 26–28, illus.

Evolution of the Stratocruiser. Richard L. Rouzie. *Boeing Magazine*, Vol. 14, No. 2, February, 1949, pp. 18, 19, illus.

Sea Fury Trainer (Mk. 20, Hawker). *Flight*, Vol. 55, No. 2093, February 3, 1949, p. 133, illus.

What Will Replace the Dakota? L. Maxwell-Holyroyd. *Indian Skyways*, Vol. 2, No. 12, December, 1948, pp. 17–27, 29–31, illus. An evaluation of the de Havilland "Dove" and the Percival "Prince" landplanes and the Short "Sealand" and Grumman "Mallard" amphibians as replacements for the DC-3 on India's internal air-line routes.

Flying the Nene-Viking (Jet Transport). R. G. Worcester. *The Aeroplane*, Vol. 76, No. 1962, January 14, 1949, pp. 46, 47, illus., diagr.

The Bristol Brabazon Airliner. A. E. Russell. *The Engineering Journal*, Vol. 32, No. 2, February, 1949, pp. 69–71, illus.

The Airspeed Ambassador. *Aircraft Engineering*, Vol. 21, No. 240, February, 1949, pp. 42–48, illus., diagrs.

A critical review of some of the technical features of the British European Airways' Corporation's future mainliner: developmental history, wing design, fuselage, controls, power plants, fuel system, hydraulics, undercarriage, electrical services, deicing, passenger and crew arrangements, and the pressurization system.

Hermes IV. *Handley Page Bulletin*, Vol. 14, No. 164, October, 1948, pp. 3–6, illus., diagrs. The flight deck of the Hermes IV is designed for fewer cockpit attachments and more unified panels for the navigator, flight engineer, and radio operator.

Pilot's Primer (Fairey Trainer). *Aeronautics*, Vol. 20, No. 4, March, 1949, pp. 42, 43, illus.

Super Ace (Series II Chrislea). *Aeronautics*, Vol. 20, No. 4, March, 1949, p. 30, illus.

Handling Notes on the Miles M.14 (Magister). Stanley Orton Bradshaw. *The Light Plane*, Vol. 2, No. 10, January, 1949, pp. 3–5, illus., diagrs.

Mamba Balliol (I, Boulton Paul Advanced Trainer "In the Air"; Experience Behind a Small Turboprop: Pitch and Power Control. Maurice A. Smith. *Flight*, Vol. 55, No. 2093, February 3, 1949, pp. 123–125, illus.

Fokker S.11 Instructor in the Air; Principal Features Described: Performance Assessment of Holland's New Basic Trainer. Maurice A. Smith. *Flight*, Vol. 55, No. 2096, February 24, 1949, pp. 218–221, illus., diagrs.

The SAAB Scandia. George Galitzine. *Indian Skyways*, Vol. 3, No. 1, January, 1949, pp. 13–15, 17, illus.

Something New for Canada (Found Brothers F-2 Personal Aircraft). *Aircraft and Airport*, Vol. 11, No. 2, February, 1949, pp. 20, 21, illus., diagr.

First Chilean-Built Aircraft (Maetranza Central de Aviacion, Triciclo-Experimental Two-Seater). *Flight*, Vol. 55, No. 2093, February 3, 1949, p. 126, illus.

New Czech Aircraft. *The Aeroplane*, Vol. 76, No. 1962, January 14, 1949, p. 48, illus.

New Polish Aircraft. *The Aeroplane*, Vol. 76, No. 1968, February 25, 1949, pp. 212, 213, illus., diagr. Postwar design

Why Sodium Cooled Valves?

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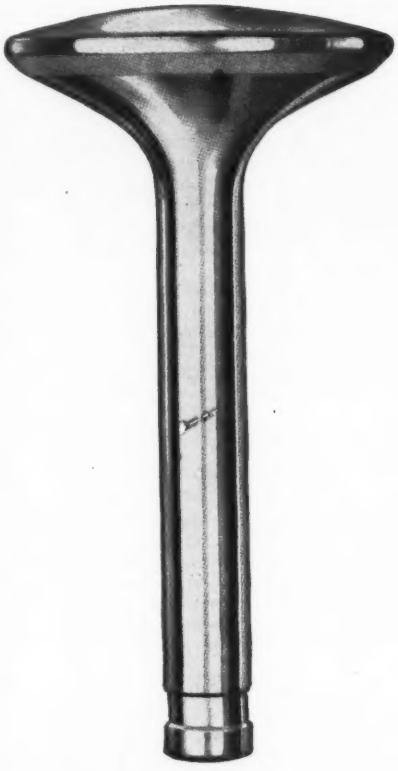

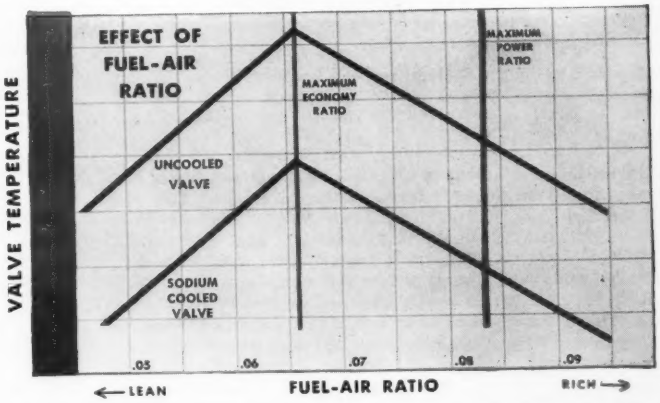

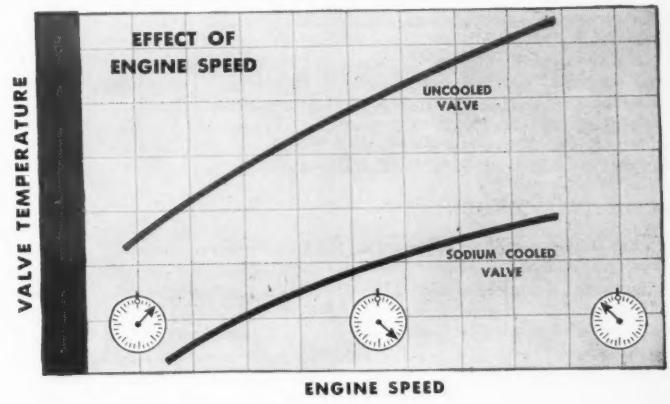

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of the Szpak, Zak, Junak, C.S.S., and Zuk series and the S.I. and Mis. light planes. These reflect Russian trends in contrast with prewar Polish aircraft.

La-9 (Russian Fighter). *Flight*, Vol. 55, No. 2095, February 17, 1949, p. 193, illus.

The OQ-19A Flying Target. *Plane Facts*, Vol. 6, No. 2, February, 1949, pp. 24, 25, illus.

Homemade Air Sled Weighs Less Than Pilot (Wee-Bee 18½-Hp. Prone-Position Ultra-Light Airplane). *Popular Science Monthly*, Vol. 154, No. 2, February, 1949, pp. 137–139, illus., diagr.

BODY GROUP

Pressurized-Cabin Elementary Frame Analysis. II. William F. Vogel. *Aero Digest*, Vol. 58, No. 2, February, 1949, pp. 48, 49, 51, 78, figs.

An approximate solution for a continuous statically indeterminate pressurized frame, the conventional elliptical semi-monocoque fuselage in which the frame loading under internal pressure lies between limits defined by the frames carrying the entire pressure and the skin being fully effective in hoop tension. The hoop tension is considered to be variable and to depend on the peripheral spacing of stringers. The accuracy of the method is sufficient for preliminary design of structures.

CONTROL SYSTEMS

Revision to Control System No-Load Friction Values. *Boeing Service Guide*, No. 16, January, 1949, p. 8, diagr.

FUEL TANKS

Investigation of Aerodynamic and Icing Characteristics of Recessed Fuel-Vent Configurations. Robert S. Ruggeri, Uwe von Glahn, and Vern G. Rollin. *U.S., N.A.C.A., Technical Note No. 1789*, March, 1949. 63 pp., illus., diagrs., figs. 2 references.

Conducted in the N.A.C.A. Cleveland icing research tunnel. The fuel vents were investigated aerodynamically to obtain vent-tube pressures and pressure distributions on the ramp surface as functions of tunnel-air velocity and angle of attack. Icing investigations were made to determine the vent-tube pressure losses for several icing conditions at tunnel-air velocities ranging from 220 to 440 ft. per sec. The vent configuration under nonicing conditions with diverging ramp walls, 7° ramp angle, and vent tubes manifolded to a plenum chamber gave greatest vent-tube pressures for all conditions investigated. Configurations with diverging ramp sidewalls gave greater vent-tube pressures than configurations with parallel sidewalls. In similar cloud-icing conditions only the configuration with a plenum chamber maintained adequate vent-tube pressures throughout 60-min. icing periods. No complete closure of vent-tube openings due to ice formations occurred for configurations investigated.

PRELIMINARY DESIGN

The Design of Highspeed Aircraft. Ben Lockspeiser. *Indian Skyways*, Vol. 3, No. 1, January, 1949, pp. 20, 21, 23, illus.

Servicing Experience and Aircraft Design. Norman and Wilkinson. *The Aeroplane*, Vol. 76, No. 1968, February 25, 1949, pp. 224–226. (Extended summary of a paper: Aircraft Servicing).

Are Supersonic Biplanes Next? Alan Pope. *Air Trails*, Vol. 32, No. 1, April, 1949, pp. 21–23, 77, 78, illus., diagr. The Busemann biplane reflection system in which leading-edge shocks cancel low-pressure regions behind the wings.

Readers' Forum: Suitability of Flying Wings as Jet Airplanes. J. V. Foa. **Author's Reply.** I. L. Ashkenas. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 253–255. 4 references.

Airports & Airways (39)

Airport Zoning. J. Nelson Young. (*University of Illinois, Bulletin, Vol. 46, No. 29, December, 1948*) *University of Illinois, The Institute of Aeronautics, Urbana, Ill., Aeronautic Bulletin, No. 4*, December, 1948. 76 pp., folding charts. 67 references.

The integration of airport zoning with regional planning is based upon the incidence of urban development in the vicinity that will be stimulated by the establishment of major transportation terminals. Problems include the selection of facilities to meet future requirements and the avoidance of an improper spacing and overdevelopment. Future airport zoning, as part of a regional plan, requires the selection of both major airport terminals and airport facilities for lighter personal craft. The planning of the latter in conjunction with community parks should provide a sound basis of selection. Steps in the advance selection of airport sites through regional planning have been taken by King County, Wash., and Cook County, Ill. Sources of assistance in preparing a zoning ordinance include the National Institute of Municipal Law Officers; the C.A.A.; the Airport Operations Service; Office of Airports, Washington, D.C.; and the Air Transport Association of America, Washington, D.C.

Résumé of United States Planning in Air Navigation Traffic Control, Communication. *U.S., Radio Technical Commission for Aeronautics, SC30, Paper 85–48/DO-19*, September 1, 1948. 9 pp., illus., diagrs. The transition from past through interim to projected systems of primary navigational information, traffic control, and communication.

Equipment Standards Airdrome Control Stations. *U.S., Radio Technical Commission for Aeronautics, SC29, Paper 66–47/DO-4*, May 16, 1947. 11 pp.

An enumeration of the basic equipment required by an airport traffic control station; the equipment that is desirable at present and, with the expansion of operations, will become essential; and a list of fundamental factors to be considered in the design of an airport and its facilities which will contribute to operating efficiency.

Air Traffic Control. *U.S., Radio Technical Commission for Aeronautics, SC31, Paper 27048/DO-12*, May 12, 1948. 91 pp., diagrs. The objectives, principals, and operational requirements of an air traffic control and navigation system; its area of control and administration, the time-cost factors of basic equipment, and a narrative description of the system in operation.

Standardization of DME Test Procedures. *U.S., Radio Technical Commission for Aeronautics, SC40, Paper 95-48/DO-21*, October 4, 1948. 15 pp.

To facilitate a comparison of the Narrow Band System and the Pulse Multiplex System methods for realizing multiple operating channels in the DME element of the R/Theta system of Air Navigation and Traffic Control. This includes an outline of test procedures that bring out performance characteristics of all elements and a tabulation and evaluation of data in an appropriate form.

DME System Characteristics (Transition Period). *U.S., Radio Technical Commission for Aeronautics, SC40, Paper 121-48/DO-24*, December 15, 1948. 155 pp., illus., diagrs., figs.

A technical plan to implement a Transition Period Distance Measuring System. Characteristics of the system allow adequate frequency space for the development and utilization of the navigable portion of the Ultimate Common System. Report includes the recommended plan, information on the factors that effect the methods of the DME channeling, and the results of the tests of the Narrow Band and Pulse Multiplex DME System previously developed.

Performance Characteristics; Private-Line/Transpondor Element of the Common Air Traffic Control System and the Transition Period Transpondor. *U.S., Radio Technical Commission for Aeronautics, SC41, Paper 96–48/DO-22*, October 6, 1948. 37 pp., diagrs., figs. An air-ground communication link based upon pulsed radio frequency techniques which establishes the locations of aircraft and enables air-to-ground and ground-to-air communication via private line.

Air Traffic Control Procedures (Transition Period). *U.S., Radio Technical Commission for Aeronautics, SC45*, Paper 90-48/DO-20, September 1, 1948. 22 pp., diagrs., figs.

Detailed operating procedures and charts for a New York-Chicago V.H.F. Omni and LF/MF Radio Range Airway. It includes a chart of recommended use of V.H.F. radio navigation facilities (in addition to I.L.S.) in the New York area showing omni bearing lines to be used in conjunction with LF/MF radio ranges and a similar chart for the Chicago terminal area.

Saab's Traffic Control. Bertil Carlsson. *Saab Sonics*, No. 5, January–March, 1949, pp. 2–4, illus.

Rules of the Instrument Road. Bill Dixon. *Air Facts*, Vol. 12, No. 3, March 1, 1949, pp. 48–55. Rules and procedures of air traffic control during range flying and within airport zones.

PROCEEDINGS

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The Cocos Islands; An Account of the Development of a Coral Atoll in the Indian Ocean. D. Martin Butcher. *Flight*, Vol. 55, No. 2095, February 17, 1949, pp. 201–203, illus.

Pass the Hat—and Build Your Airport. *Southern Flight*, Vol. 31, No. 2, February, 1949, pp. 32–34, illus. The financing of an airport by the town of Filippin, Ark.

America's Air Navigation Program; An Appraisal of the Needs and the Benefits. D. W. Rentzel. *U.S., Civil Aeronautics Administration*. April 15, 1949. 26 pp. (Statement Made Before Senate Committee on Interstate and Foreign Commerce.)

Aviation Medicine (19)

Some Biological Factors in the Design of Civil Aircraft. Barry G. King and John J. Swearingen. *Journal of Aviation Medicine*, Vol. 19, No. 6, December, 1948, pp. 414–419, 441, figs. 6 references.

Available biotechnical cockpit-design data deals with sitting height, thigh-leg angle, and arm reach. The departures from standard descriptions reported in measurements which are directly applicable to design are subjective preferences and imply a physiological and anatomical basis. The location and operation of manual controls in relation to the pilot as a reference point are not well planned in current aircraft. A description of reach, determined by the Naval Medical Research Institute, showed that all controls on the DC-4 but one are beyond the maximum limit.

Requirements for Oxygen in Commercial Aviation. L. D. Carlson, W. R. Lovelace, II, and Henry L. Burns. *Journal of Aviation Medicine*, Vol. 19, No. 6, December, 1948, pp. 399–413, illus., diagrs., figs. 29 references.

The physiological, medical, and engineering bases that prescribe the equipment for breathing systems in airplanes. Pulmonary ventilation requirements for altitudes to 40,000 ft. and a low-pressure system with automatic flow control are given.

Protective Helmet for Pilots of High-speed Aircraft. E. Hendler and J. R. Poppen. *Journal of Aviation Medicine*, Vol. 19, No. 6, December, 1948, pp. 420–425, 455, illus. 8 references.

The H-1 Protective Helmet. A laminated plastic shell, with a reinforcing glass fabric embedded with thermosetting polyester resins, is padded with chamois-covered sponge rubber. Standard ANB-H-1 magnetic-type headset receivers are located in the padding, and a lip-type microphone on a boom support is riveted directly to the right side of the shell. Complete weight is approximately 1.75 lbs Evaluation thus far is favorable with the exception of inadequate ventilation within the helmet.

Acceleration (G. Forces) Research Equipment, Studies, Results and Training. *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.O.S./J.A.P./P.R./264*, December 7, 1945. 99 pp., illus., diagrs., figs. 35 references. British Information Services, New York. $3.65. The human centrifuge at Tachikawa and at the Army Medical College, Tokyo, the animal centrifuge at Tohuku Imperial University, Sendai, Honshu, and at the Navy Aero-Medical Division, Yokosuka. It includes a report on the influence of centrifugal forces on the intermediary carbohydrate metabolism.

Air Force Develops Pilot Bed for Flying at High Speed. *The Martin Star*, February, 1949, p. 10, illus.

Dragerwerk, Lubeck, Germany. W. R. Lovelace, A. J. Vorwald, C. L. Pratt, T. T. B. Boissard, and W. J. Wulff. *Combined Intelligence Objectives Sub-Committee, Item No. 8, 24, 27, File No. 27–61*. 55 pp. British Information Services, New York. $1.60. Development of oxygen supply systems and equipment. Includes description of portable units for parachutes, ejection seats, and *g* suits.

Comfortization (23)

Lubrication of Cabin-Pressurization and Air-Conditioning Systems. D. N. Harris. *Shell Aviation News*, No. 127, January, 1949, pp. 17–22, diagrs. The pressure and air-conditioning systems on Lockheed Constellation Models 049, 149, 649, and 749; The Douglas DC-6; the Convair-Liner; and the Boeing Stratocruiser. It gives recommended lubricants.

Education & Training (38)

Boeing Stratocruiser School. *Boeing Service Guide*, No. 17, February, 1949, pp. 2–7, illus. Familiarization training of operators' personnel.

Prentices and Pupils. *The Aeroplane*, Vol, 76, No. 1966, February 11, 1949, pp. 153, 154, illus. Training program at the R.A.F. College, Cranwell.

Are Spins Really Necessary? Lew Gourley. *Air Facts*, Vol. 12, No. 3, March 1, 1949, pp. 28–31. The advisability of eliminating spins from the private-pilot flight test.

Flight Emergencies Made to Order (The Curtiss-Wright Simulator). *New Zealand Flying*, Vol. 2, No. 17, January 15, 1949, p. 4, illus.

Electronics (3)

Airline Radio. Robert Hertzberg. *Radio & Television News*, Vol. 41, No. 3, March, 1949, pp. 35–37, 161, illus., diagr. Communications equipment installations of the Constellations used by American Overseas Airlines, Inc.

New "Two-Method" Phase Meter Makes Possible World-Wide Navigation Systems. E. F. Florman. *Instruments*, Vol. 22, No. 1, January, 1949, pp. 40, 41, illus.

Three-Dimensional Cathode-Ray Tube Displays. E. Parker and P. R. Wallis. *Institution of Electrical Engineers, Journal*, Vol. 95, No. 37, September, 1948, pp. 371–387, Discussion, pp. 387–390, illus., diagrs., figs. 11 references.

The display of three-dimensional information, with particular reference to a radar system, in which a narrow pulsed beam of radio-frequency energy is used to explore automatically a volume of space. Three-dimensional displays show the positions of the reflected radar "signals" with respect to the three coordinates of the volume. The "truly three-dimensional displays" utilize a mechanical motion to add a third dimension to the screen of the cathode-ray tube so that the picture appears as an actual volume. The "perspective displays" simulate the same picture as in the previous display without any moving mechanisms; rotation of the volume and/or stereoscopy is used to give the impression of three dimensions. The "oblique displays" obtain the required three coordinates by combinations of two or more two-coordinate pictures on the same cathode-ray tube. The "polychromatic displays" use color to represent a spatial coordinate.

Advantages and Disadvantages of Frequency and Phase Modulation in the Light of the Special Requirements Demanded by Aviation, as Well as its Application to Wireless Navigation. (*Gt. Brit., Ministry of Supply, TPA3/TIB Translation No. GDC 10/6039 T.*) *Gt. Brit., British Intelligence Objectives Sub-Committee, Miscellaneous Report No. 83*, April, 1948. 282 pp., illus., diagrs., figs. 294 references. British Information Services, New York. $6.50.

Contents: Advantages and Disadvantages of Frequency and Phase Modulation in the Light of the Special Requirements Demanded by Aviation, as Well as its Application to Wireless Navigation, J. Brunswig, W. Koepfer, and M. Vieweger. (*Lilienthal Gesellschaft für Luftfahrtforschung*, Bericht Nr. S. 12, 1942). The Utilization Possibilities of Frequency and Phase Modulation in Wireless Transmission and Wireless Navigation Technique, W. Nestel. Frequency Modulation; its Characteristics and Methods and its Importance for Aircraft Wireless, W. Roder.

Research Work Undertaken by the German Universities and Technical High Schools for the Bevollmaechtigter Fuer Hochfrequenz-Technik; Independent Research on Associated Subjects. R. M. Whitmer, M. Snowdon, and others. *Combined Intelligence Objectives Sub-Committee, Item No. 1, 7, File No. 31–2*. 80 pp. British Information Services, New York. $2.20.

History of the research establishment, staff, current projects, and reports of interrogation of individuals in physics, mathematics, electronics, and nuclear physics research groups associated with the Universities of Strassbourg, Tübingen, Darmstadt, München, Königsberg, Graz, Göttingen, Erlangen, Vienna, Liepzig, Leiden, and Amsterdam; the Technische Hoshschule of Karlsruhe, Aachen, Darmstadt, Hanover, Braunschweig, Berlin, and Danzig; the Technische Physikalische Institut of Jena; the Niels Bohr. Institute, Copenhagen; and the Mathematische Reichsinstitut, at Oberwalfach, Freiborg.

Rugged Valves and Mechanical Tests for Valves and Components. N. W. Robinson. Gt. Brit., *British Intelligence Objectives Sub-Committee, Final Report No. 501, Item Nos. 2, 9, 11, 12, 13*. 29 pp., illus. British Information Services, New York. $1.00. Design and construction of SG1A and SG3, shock-resistant triodes, and description of mechanical test equipment for determining the endurance of electronic tubes and components under high acceleration, vibration, and shock.

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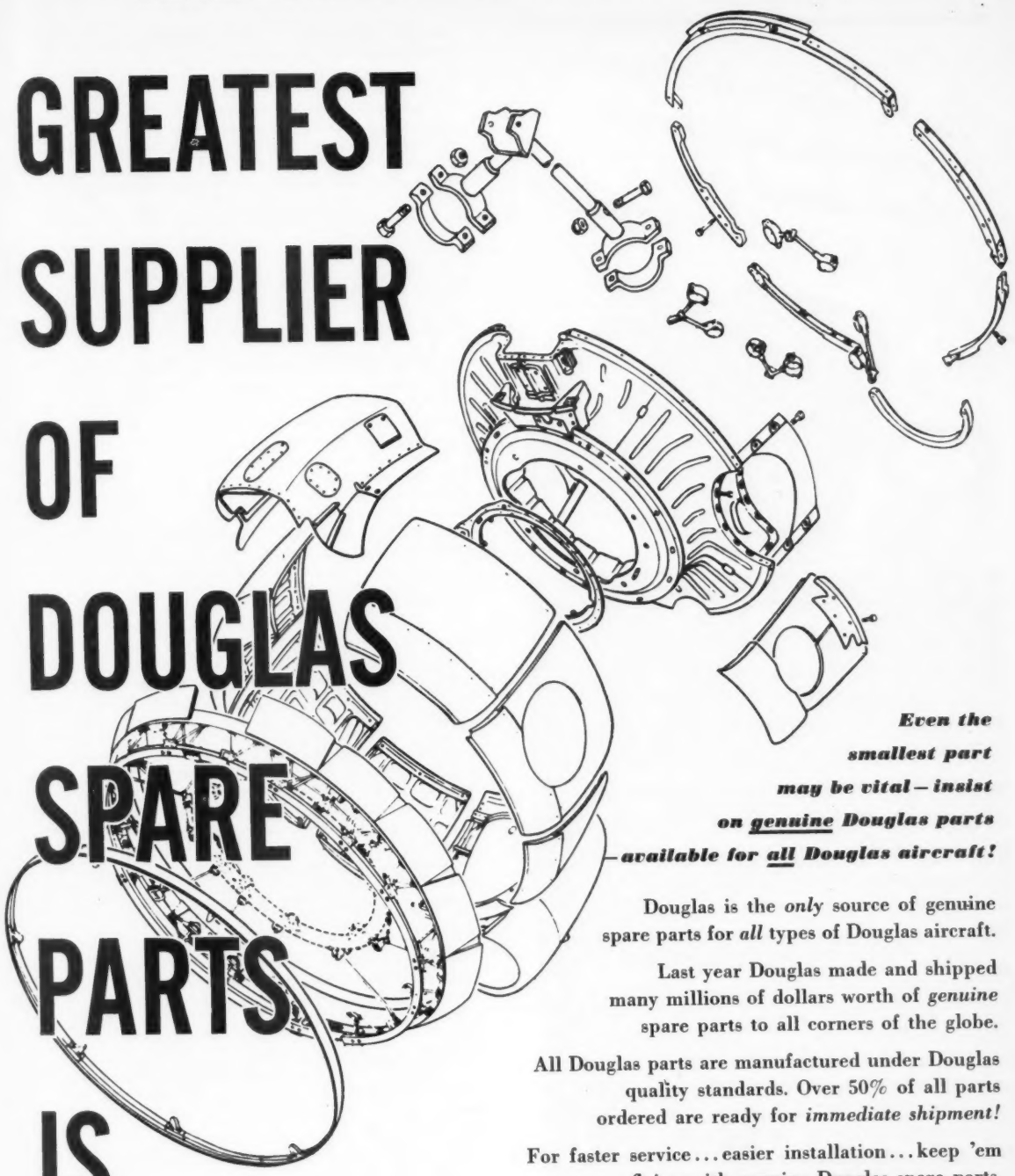

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Institut für Physikalische Forschung Neu Drossenfeld. Walter Hauz. *Combined Intelligence Objectives Sub-Committee, Item No. 1, 6, File No. 28–41,* June 30, 1945. 27 pp., figs. British Information Services, New York. $0.90.

A small independent group for the development of a television homing device, under the leadership of Dr. Rambauske. It was affiliated with the Gesellschaft für Forschung und Entwicklung and sponsored by the Luftwaffe. A square wave pulse, the duration of which corresponded to the direction of the correction required to center the target on an inoscope, and a signal synchronized with the scan generator were resolved into two d.c. signals proportional to the required vertical and horizontal correction.

Test Gear for Frequency Modulation and Television. D. Moody, J. A. Pouliot, and H. Page. *Gt. Brit. British Intelligence Objective Sub-Committee, Final Report No. 1269, Item No. 7,* 30 pp., diagrs., figs. British Information Services, New York. $1.15.

Targets: Siemens Halske, Berlin, Munich, and Erlangen; Hans Roder, Berlin; Telefunken G.m.b.H. Berlin; Lorenz G.m.b.H., Berlin; Hamburg FM Police Communication System; Dr. Kroebel, Guericke G.m.b.H., Kiel; Deutsche Reich Post, Aach, Singen, Baden; and P. Gossen, Erlangen.

Theory and Design of a Waveguide Below Cutoff Attenuator. J. J. Freeman. *U.S., National Bureau of Standards, Central Radio Propagation Laboratory, Report No. CRPL-9–2,* December 27, 1946. 30 pp., diagrs., figs. 7 references.

The Basis of the Application of Network Equations to Waveguide Problems. David M. Kerns. *U.S., National Bureau of Standards, Central Radio Propagation Laboratory, Report No. CRPL-9–5,* June 30, 1948. 66 pp., figs.

A Standard of Attenuation for Microwave Measurements. R. E. Grantham and J. J. Freeman. *U.S., National Bureau of Standards, Central Radio Propagation Laboratory, Report No. CRPL-9–8,* October 4, 1948. 7 pp., diagrs., figs. 6 references.

Microwave Frequency Measurements and Standards. B. R. Husten and Harold Lyons. *U.S., National Bureau of Standards, Central Radio Propagation Laboratory, Report No. CRPL-9–7,* October 1, 1948. 8 pp., illus., diagrs. 6 references. (Reprint.)

Terminal Report of Microwave Measurement Standards Section on Very High Frequency Field Intensity Standards. H. E. Sorrows, R. C. Ellenwood, and W. E. Ryan. *U.S., National Bureau of Standards, Central Radio Propagation Laboratory, Report No. CRPL-9–1,* November, 8 1946. 41 pp., diagrs., figs.

Determination of Efficiency of Microwave Bolometer Mounts From Impedance Data. David M. Kerns. *U.S., National Bureau of Standards, Central Radio Propagation Laboratory, Report No. CRPL-9–6,* August 10, 1948. 17 pp., figs. 2 references.

Absorption of Radio Waves Reflected at Vertical Incidence as a Function of the Sun's Zenith Angle. Eloise W. Taylor. *U.S., National Bureau of Standards, Journal of Research,* Vol. 41, No. 6, December, 1948, pp. 575–579, figs. Available also as *Research Paper No. RP1939.* U.S. Govt. Printing Office, Washington. $0.10.

An Instrument for the Measurement and Time Integration of Small Voltages and Currents. I. A. D. Lewis and A. C. Clark. *Journal of Scientific Instruments,* Vol. 26, No. 3, March, 1949, pp. 80–84, diagr., fig. 7 references.

The Transistor—A New Semiconductor Amplifier. J. A. Becker and J. N. Shive. *Electrical Engineering,* Vol. 68, No. 3, March, 1949, pp. 215–221, illus., figs. 9 references.

The Coaxial Transistor. Winston E. Kock and R. L. Wallace, Jr. *Electrical Engineering,* Vol. 68, No. 3, March, 1949, pp. 222, 223, illus., fig. 2 references. Construction, characteristics, and advantages.

Subminiaturization of I-F Amplifiers. *U.S., National Bureau of Standards, Technical Report No. 1331,* March, 1949. 12 pp., illus. 1 reference.

Destruction of Superconductivity by Current. Russell B. Scott. *U.S., National Bureau of Standards, Journal of Research,* Vol. 41, No. 6, December, 1948, pp. 581–600, figs. 28 references. Available also as *Research Paper No. RP1940.* U.S. Govt. Printing Office, Washington. $0.10.

An Apparatus for the Production of Large Metallic Crystals by Solidification at High Temperatures. Louis Gold. *Review of Scientific Instruments,* Vol. 20, No. 2, February, 1949, pp. 115–121, illus., diagr., figs. 26 references.

A Simple Direct-Reading Fluxmeter. J. H. Briggs and W. H. Mitchell. *Journal of Scientific Instruments*, Vol. 26, No. 2, February, 1949, pp. 40–42, illus., fig.

A new type of fluxmeter with a soft iron movement which is simple and robust. It is direct reading and requires no external connections, and it can be adapted for measurement of the flux densities of variously shaped magnets to an accuracy of 2 per cent.

Engineering Practices (49)

Electronic Computer Applications. I. David Fidelman. *Radio & Television News*, Vol. 41, No. 3, March, 1949, pp. 3–6, 26, 27, illus., diagrs. The use of digital and analogue computers in industrial processes.

Equipment

ELECTRICAL (16)

A 24,000-Rpm Alternator for Aircraft. T. J. Martin. *Electrical Engineering*, Vol. 68, No. 3, March, 1949, p. 243, illus., diagr.

The G-80 alternator is a 50-kw. generator for supplying a.c. power to three-phase 208/120-volt 400-cycle aircraft electric systems. The light high-speed electric rotating equipment can be connected directly to a high-speed gas turbine, thereby eliminating the noise and vibration of a reciprocating engine.

A Rectified A-C Electric System for Aircraft. L. M. Cobb, W. L. Kershaw, and Q. E. Erlandson. *Electrical Engineering*, Vol. 68, No. 2, February, 1949, pp. 95–101, illus., diagrs., figs. 4 references.

An adequate replacement for a conventional d.c. installation which eliminates mounting large, heavy generators on the engine accessory case and provides adequate output at low engine speeds. Four 30-volt 16-kva. delta-connected twelve-pole three-phase alternators mounted on two aircraft engines and four three-phase full-wave bridge-type rectifiers consisting of 96 selenium plates provide approximately 1,000 amp. d.c. at 28 volts and fulfill peak demands as high as 3,200 amp. Ducted rectifier housings supply cooling air at a pressure equivalent to 6 in. of water total head, which enables the unit to carry 400 amp. at 28 volts. Two 34-amp.-hour 24-volt batteries are used for initial field excitation of the alternators and stabilize the system in case of heavy short circuit of the bus. Normal ground operation is limited to a minimum engine speed of 80 r.p.m.

Ground Power for Aircraft. John H. Blankenbuehler. *Electrical Engineering*, Vol. 68, No. 2, February, 1949, p. 138, table. (Summary of a paper.)

The design of generator units that supply a constant d.c. current at constant voltage to aircraft on the ground. It includes a tabulation of the d.c. ground electric loads in amperes at 28.5 volts of the electric accessories and equipment of eight conventional aircraft.

Modern Electrical Systems; Use of High-Voltage Supplies on Large Civil Types: A New Battery Design. *Flight*, Vol. 55, No. 2090, January 13, 1949, p. 55, illus.

Contact Bridge Erosion and Its Prevention. W. G. Pfann. *Electrical Engineering*, Vol. 68, No. 3, March, 1949, p. 197, figs.

Type K and RK Connectors. *Cannon Electric K Bulletin, Supplement KS-1*, November, 1948, pp. 65–76, illus., diagrs., figs. Connector types K and RK, the K-31S1 wall mounting receptacle, K pressurized receptacles, and 16 insert arrangements in various shell sizes for radio, sound, electronic, and electrical equipment.

Precision Snap-Acting Switches. A. L. Riche. *Electrical Engineering*, Vol. 68, No. 2, February, 1949, pp. 128–134, illus., diagrs., figs. 2 references.

A Servo Employing the (National Bureau of Standards) Magnetic Fluid Clutch. E. S. Bettis and E. R. Mann. *Review of Scientific Instruments*, Vol. 20, No. 2, February, 1949, pp. 97–101, diagrs., figs. 1 reference.

NEMA (National Electrical Manufacturers Association.)—Motor Standards. *Product Engineering*, Vol. 20, No. 3, March, 1949, pp. 137–152, diagrs., figs. Includes: frame size and dimensions, horsepower ratings, service factors, temperature rise, and performance characteristics.

HYDRAULIC & PNEUMATIC (20)

Reciprocating Seals. F. H. Towler. *The Engineer*, Vol. 187, No. 4857, February 25, 1949, p. 229, diagr., fig. (Extended summary of a paper.) Working conditions encountered by reciprocating seals compared with those of rotary seals, the mechanism of the automatic seal under static conditions of motion and friction, packingless pistons, and J. H. F. Stewart's shaft hydraulic seal for aircraft pumps.

Rotary and Oscillating Seals. T. E. Beacham. *The Engineer*, Vol. 187, No. 4857, February 25, 1949, pp. 228, 229, diagrs. (Extended summary of a paper.)

Automatically adjustable shaft seals. This includes cross-sectional views of ten metal and carbon face seals. For use with high-speed shafts, they are suitable for particularly difficult sealing problems.

Flight Operating Problems (31)

CLIMATIZATION

Cold Weather Operation of Aircraft. G. W. Wilson and E. P. Bridgland. *Royal Aeronautical Society, Journal*, Vol. 53, No. 457, January, 1949, pp. 1–30, Discussion, pp. 31–38, illus., figs. 4 references.

Experience obtained at the Royal Canadian Air Force Experimental Establishment at Edmonton, Alberta, Canada, shows that the chief factors affecting the consistent and dependable operation of aircraft under arctic conditions are the rate of cooling, or Wind Chill Factor, and the penetration of driven snow into the interior of the aircraft. Cold-weather problems differ from high-altitude operating problems in that the low temperatures met in flight are of short duration. During dispersal in the arctic, the low temperatures soak the aircraft and cause differential expansion of the various air frame and engine components, cracking of electrical insulating materials, failure of glands and packings in hydraulic or pneumatic systems, and the solidification of oils and greases. The use of a Hotwell-Hopper partial circulator, assuring a supply of warm oil when the engine is started, and the dilution of the lubricant to increase its fluidity have permitted consistent cold starts without a supplementary heat source at an outside air temperature of —35°C. for reciprocating engines and at —45°C. for gas-turbine engines. In order to avoid extreme changes in the temperature of the aircraft, maintenance must be performed out of doors. Improvement should be made in the presently cumbersome clothing that restricts movement and further decreases the efficiency of personnel.

ICE PREVENTION & REMOVAL

Stratocruiser Thermal Anti-Icing System. *Boeing Service Guide*, No. 17, February, 1949, pp. 8–14, diagrs. Eight electrically controlled combustion heaters supply heated air to the inner surfaces of all critical leading-edge skin areas of wings and tail.

PILOTING TECHNIQUE

Instrument Flying at AMC. *Plane Facts*, Vol. 6, No. 2, February, 1949, pp. 11, 12, 30, illus.

WEATHER HAZARDS

Precipitation Static. P. F. Duncan. *Institute of Navigation, Journal*, Vol. 2, No. 1, January, 1949, pp. 53–56.

Suggested means of preventing the accumulation of static electrical charges of airplane surfaces which permit the operation of radio navigation and communication equipment under conditions of precipitation static four to five times more severe than could be tolerated without them.

Static Discharges From Aircraft. W. A. Johnson. *Flight*, Vol. 55, No. 2096, February 24, 1949, pp. 223, 224, illus. Multipoint wicks of metal-impregnated cotton can discharge the static charge of an airplane and minimize precipitation static.

Flight Safety & Rescue (15)

Crash Rescue in the AAF. *Plane Facts*, Vol. 6, No. 2, February, 1949, pp. 6–8, 30, 32, illus.

Special Protective Garment for Aviators. (**Seenotschutzgerät**). Jean G. Kern. *Combined Intelligence Objectives Sub-Committee, Item No. 22, File No. 23-9,* May, 1945. 7 pp. British Information Services, New York. $0.35. A three-layer fabricated-cloth suit, enclosing a powder foaming agent that reacts with cold sea water to produce a stable protective layer of foam, permitting the wearer to remain in the water for many hours.

Accident Prevention in Transport Command. *The Aeroplane,* Vol. 76, No. 1967, February 18, 1949, p. 185, illus.

Flight Testing (13)

Flight Testing the Scandia. Erik Bratt. *Saab Sonics,* No. 5, January–March, 1949, pp. 5–9, 24, illus., figs.

Fuels & Lubricants (12)

Non-Metallic Materials for Aircraft: Visits to Research Establishments in Germany. T. R. Thomas, M. G. M. Pryor, G. A. Earwicker, and F. Sebba. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 361, Item Nos. 4, 21, 22, 25, 26, 30.* 50 pp., illus. British Information Services, New York. $1.45.

Brief outlines of the research programs of the Institute for Fuel Research of the D.V.L. (Berlin), Oberhausen, the Institute for Fuels and Lubricants, Oberlangenstadt (originally of the University of Leipzig), and the Institute of Thermodynamics of the D.V.L. (Berlin), Garmish-Partenkirchen. One hundred and forty-one research reports and memorandums are listed.

Compression Ignition Applied to the Otto Cycle; The Ring Process. M. O'Farrell. *Gt. Brit., Britsih Intelligence Objectives Sub-Committee, Final Report No. 1609, Item. No. 30.* 13 pp. British Information Services, New York. $0.70.

Guide for the Lubrication of Military Aircraft. E. M. Glass. *Aero Digest,* Vol. 58, No. 2, February, 1949, pp. 65, 66, 68–70, 72, 74, fig., tables. 4 references.

Five tables listing: the characteristics of the major lubricants used by the U.S. Air Force; specification numbers, supersedences, and applicable bulletins of approved products; and typical applications of AN-L-32 lubricants for aircraft components and air-borne electrical equipment. It includes a graph of viscosity-temperature characteristics based on specification limits of various oils.

Major Developments in Synthetic Lubricants and Additives in Germany. H. L. West. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 1611, Item. No. 30.* 150 pp., figs., tables. 600 references. British Information Services, New York. $4.00. Based on reports of Allied Technical Intelligence Teams that operated after World War II, documents and company records, and interrogations of individuals of I.G. Farben-industrie, Rhenania-Ossag, Ruhrchemie, Rheinpreussen, A.G., and Deutsche Vacuum Oel, A.G.

Japanese Fuels and Lubricants: Naval Research on Lubricants. U.S. Naval Technical Mission to Japan. *Gt. Brit., British Intelligence Ojectives Sub-Committee, Report No. B.I.-O.S./J.A.P/P.R./1155,* February, 1946. 458 pp., illus., diagrs., figs. British Information Services, New York. $10.80. Research program of the First Naval Fuel Depot, Ofuna, Japan, on improved methods of refining crude stocks, the exploitation of non-petroleum sources of synthetic lubricants, and the development of lubricant additives.

Japanese Fuels and Lubricants: Naval Research on Aviation Gasoline. U. S. Naval Technical Mission to Japan. *Gt. Brit., British Intelligence Objectives Sub-Committee, Report No. B.I.-O.S./J.A.P./P.R./1313, February, 1946.* 446 pp., illus., diagrs., figs. British Information Services, New York. $10.80.

The research program of the First Naval Fuel Depot, Ofuna, Japan, for increasing the production of aviation gasoline. Projects included the hydrogenation of mineral oil, the hydrogenation of cracked gasoline, the utilization of vegetable sugars, combustion studies, and single-cylinder and full-scale engine testing.

Lubrication Requisites in Sealed Ball Bearings; Considerations That Will Aid the Designer in Selecting or Constructing Pre-Lubricated Sealed Ball Bearings for Different Uses. D. E. Batesole. *Product Engineering,* Vol. 20, No. 3, March, 1949, pp. 107–110, illus., diagrs.

Gliders (35)

What Performance Is Attainable in Soaring Flight? Joachim Kuettner. *Interavia,* Vol. 4, No. 1, January, 1949, pp. 33, 34.

The utilization of meteorological phenomena during glider flights to attain altitudes of over 65,000 ft. and distances of over 600 miles. The Alps and mountains in polar regions provide currents on which such altitudes may be reached.

An Interesting Experiment (**de Havilland G.2** (**Modified Suction-Wing Glider**). *The Aeroplane,* Vol. 76, No. 1962, January 14, 1949, pp. 42, 43, illus., diagr.

Production Inspection (**at the Saab Works**). Gunnar Samuelson. *Saab Sonics,* No. 5, January-March, 1949, pp. 16–18, 24, 25, illus.

The Occurrence of Soarable Air Over the British Isles. Jaques Cocheme. *Flight,* Vol. 55, No. 2096, February 24, 1949, pp. 225–229, illus., figs. Typical British weather situations and the development of layers of unstable air suitable for service.

Gliding in France; Subsidized Soaring: Opportunities for Youth. *Flight,* Vol. 55, No. 2093, February 3, 1949, pp. 144, 145.

Guided Missiles (1)

Limitations of the Long-Range Missile. Willy Ley. *Antiaircraft Journal,* Vol. 92, No. 1, January-February, 1949, pp. 28, 29.

The lack of guidance beyond the point of maximum acceleration, the danger of incineration, and the limitation in practical take-off size are characteristics of the surface-to-surface rocket missile which limit its use to augmenting rather than replacing either artillery or bombardment aircraft.

Operational Aspects of Guided Missiles. I. Howard B. Hudiburg and Richard G. Thomas. *Antiaircraft Journal,* Vol. 92, No. 1, January-February, 1949, pp. 13–17. Weapons that will probably be developed and their characteristics, tactical employment, strategic and tactical considerations, organization and training aspects, and logistics and supply problems.

Radio-Controlled Bombs (**Tarzon, Rozon, and the JB-2 Pulse Jet**). *U.S., Central Air Documents Office* (*Navy-Air Force*), *Technical Data Digest,* Vol. 14, No. 5, March 1, 1949, p. 14.

Flight Testing Ram Jets With Martin Guided Missiles. *Shell Aviation News,* No. 127, January, 1949, p. 23, illus.

Flight of a Missile (**Gorgon IV**). *The Martin Star,* February, 1949, pp. 16, 17, illus.

USAF Reveals Development of Two Guided Missiles (**Consolidated Vultee 774 and the NATIV**). *U.S., Central Air Documents Office* (*Navy-Air Force*), *Technical Data Digest,* Vol. 14, No. 5, March 1, 1949, pp. 12, 13.

Possibility of Photosynthesis on Mars. James Franck (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets.* Gerard P. Kuiper, editor. Chicago, University of Chicago Press, 1949, pp. 335–356. 2 references. $7.50.

Orbital Bases. H. E. Ross. *British Interplanetary Society, Journal,* Vol. 8, No. 1, January, 1949, pp. 1–19, illus., diagrs. Operational and personnel requirements, and navigational difficulties attending the proposal for the maintenance of manned stations in outer space.

The Atomic Rocket. III. L. R. Shepherd and A. V. Cleaver. *British Interplanetary Society, Journal,* Vol. 8, No. 1, January, 1949, pp. 23–37, diagrs. 10 references. An analytical comparison of solid and gaseous reactors.

Possible Applications of the Liquid Fuel Rocket on the Earth. Hermann Oberth. (*Wege zur Raumschiffahrt. Munich, Germany, R. Oldenbourg, 1929.*) (*Ann Arbor, Michigan, J. W. Edwards, 1945, Sections 1-2.*) *Rocketscience,* Vol. 3, No. 1, March, 1949, pp. 3–6, diagrs., figs. Calculation of the impact area of a vertical ascent rocket, performance estimates, and proposed applications of the Oberth, Model-B, Alcohol-hydrogen, step rocket.

What Happened at Peenemunde? (**Was ging in Peenemunde vor.**) Hans K. Kaiser. *Rocketscience,* Vol. 3, No. 1, March, 1949, pp. 22, 23.

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Instruments, Aircraft (9)

Effect of Automatic Stabilization on the Lateral Oscillatory Stability of a Hypothetical Airplane at Supersonic Speeds. Leonard Sternfield. *U.S., N.A.C.A., Technical Note No. 1818*, March, 1949. 37 pp., figs. 9 references.

The use of an automatic pilot permits a reduction in the directional stability that is required for oscillatory stability. Calculations for an automatic pilot sensitive to a displacement in either yaw or roll and an automatic pilot sensitive to either the yawing or rolling angular velocity were made independently in an assumed idealized control system without lag. The results indicated that both automatic pilots improved the stability of the original unstable short-period oscillation. However, the automatic pilot that gave an oscillation satisfying the N.A.C.A. and military criteria for satisfactory damping-period relationship was the one sensitive to the yawing angular velocity and geared to the rudder so that rudder control is applied in proportion to the angular velocity.

The Modern Autopilot; A Dissertation on the Fundamentals of Modern Automatic Pilot Design. Meredith. *Flight*, Vol. 55, No. 2090, January 13, 1949, pp. 37, 38.

Delta Develops Data Computer. *Aviation Week*, Vol. 50, No. 14, April 4, 1949, pp. 55, 56, illus.

A computer developed by Delta Air Lines to calculate data for take-offs and landings of the DC-6. It is used with a table that contains all constant performance factors for a given runway and determines mechanically allowable take-off gross weight; allowable alternate landing gross weight; three-engined take-off gross weight; and head-wind components based on effective field lengths, winds, and outside air temperatures.

I Flew Blind on One Instrument (Sperry Zero Reader). *Popular Science Monthly*, Vol. 154, No. 2, February, 1949, pp. 143–147, illus., diagrs.

Airspeed OK? Rob F. Sanderson. *Skyways*, Vol. 8, No. 4, April, 1949, pp. 26, 27, 55, illus. Checking and cleaning the airspeed indicator.

A Safety Flight Invention (Basil W. Cocks and Australian C.S.I.R.). Charles Lynch. *Indian Skyways*, Vol. 2, No. 12, December, 1948, pp. 46, 47, illus.

The Response of Pressure Measuring Systems to Oscillating Pressures. Israel Taback. *U.S., N.A.C.A., Technical Note No. 1819*, February, 1949. 30 pp., diagrs., figs. 6 references.

Calculation of the response and lag in pressure measuring systems subjected to steady-state pressures that vary sinusoidally. Experimental results for several sample systems show good agreement with calculated values. They are presented in a form that shows the qualitative effect of varying the dimensions of system components. Once the attenuation characteristics of the tube are determined, it is possible to design a system with a required frequency response by a trial-and-error variation of parameters.

TEST & MEASURING

Servo Analyzer, Type 6. *Flight Research Engineering Corporation Preliminary Bulletin*, March 14, 1949. 10 pp., illus., diagrs.

Controls, operation, and wiring diagram of a self-contained, portable instrument for evaluating the performance or determining the optimum operating conditions of any type of servo in which the error-measuring device operates on either 60 or 400 cycles a.c. The instrument measures the resonance and the error function directly and provides data from which the transfer function can easily be calculated.

On the Elastic Behaviour of the So-Called "Bourdon" Pressure Gauge. C. B. Biezeno and J. J. Koch. (*Delft, Technische Hoogeschool, Laboratorium voor Aero- en Hydrodynamica, Mededeeling No. 158.*) *Nederlandsche Akademie van Wetenschappen, Verhandelinger*, Vol. 43, Nos. 9, 10, 1940. 16 pp., figs., tables. 9 references. (Reprint.) (In English.)

A Portable Thermistor Bridge for Micro-Meteorology Among Growing Crops. H. L. Penman and I. Long. *Journal of Scientific Instruments*, Vol. 26, No. 3, March, 1949, pp. 77–80, illus., figs.

Industrial Load Cells. *Product Engineering*, Vol. 20, No. 3, March, 1949, pp. 111–115, illus., diagrs.

Laws & Regulations (44)

Regulation as a Tool in the Development of the Air Freight Industry. III. James A. Durham and Marc J. Feldstein. *Air Transportation*, Vol. 14, No. 3, March, 1949, pp. 18, 19, 27, 28.

Machine Elements (14)

Kaiser Wilhelm-Institut fur Stromungsforschung, Abteilung Reibungsforschung, Berlin. D. A. Howes. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 325*, Item No. 30. 14 pp. British Information Services, New York. $0.55. Research included studies on the theory of lubrication, lubricity, friction and wear, and the development of instruments and techniques for the measurement of friction values.

BEARINGS

Overheating in Rotary Oil Seals. B. Cooke. *The Engineer*, Vol. 187, No. 4857, February 25, 1949, pp. 223–225, diagrs., figs.

A series of tests on proprietary oil seals for a rotary shaft, at Vickers-Armstrong, Ltd., to find a seal providing optimum sealing performance together with low effort. The seal consisted of a spreader ring, a "U" seal, and a crown header to which were attached five thermocouples of 38-gage wire. Results of these tests were sufficient to draw conclusions regarding the efficiency of this type of seal. Performance was good until the sealing lip had been spoiled by excessive self-generated heat. The outer-sealing lip appears to be unnecessary in that, if the inner seal allows oil to pass, it also will fail as it is of similar construction. Better results might be obtained by using only the spreader ring and the crown header.

Maintenance (25)

Wheels and Brakes. *Skyways*, Vol. 8, No. 4, April, 1949, pp. 44, 62, illus. Maintenance of wheels, brakes, and brake actuating mechanism. It includes possible service troubles with Goodyear single-disc brakes and master brake cylinders and their remedies.

Douglas Service, Vol. 7, No. 1, January–February, 1949. 20 pp., diagrs.

Contents: Automatic Pilot—Installation and Preflight Checks of PB-10 Automatic Pilot, DC-6. New Instrument Transformers, DC-6. Reversible Pitch Propellers—Operation of Curtiss Electric Controls and Synchronizer, DC-6. Electrical Bridge Circuits—Description and Function of Basic Bridge Circuit, DC-6. Geneva-Loc Actuator—Rework to Mounting Bracket, DC-6. Engine Mounts—Repair, Torque Values, and Inspection, DC-6. Cowl Flap Improvements—Changes Designed to Ensure Correct Operation, DC-6.

Reducing Operating Costs. *Flight*, Vol. 55, No. 2096, February 24, 1949, p. 215, illus. A system of periodic maintenance checks which relates maintenance to actual flying hours completed.

Suggested Procedure for Pre-Flight Check. *Canadian Aviation*, Vol. 22, No. 3, March, 1949, pp. 42, 52, diagr.

Materials (8)

METALS & ALLOYS

NACA and Office of Naval Research Metallurgical Investigation of Two Large Forged Discs of S-590 Alloy. J. W. Freeman and Howard C. Cross. *U.S., N.A.C.A., Technical Note No. 1760*, February, 1949. 63 pp., figs. 11 references.

In order to compare turbine-rotor discs of S-590 alloy which are forged and aged with those that are forged, heat-treated, and aged, data were obtained in tensile, impact, rupture, time-deformation, creep, and structural-stability tests conducted at 1,200°, 1,350°, and 1,500°F. Up to 1,350°F., the forged and aged disc showed outstanding properties. At 1,500°F., the disc that was forged, heat-treated, and aged displayed superior characteristics

and, except at short time periods, these properties were retained at 1,350°F.

Designing for Gas-Turbine Materials. M. H. Young. (Institute of the Aeronautical Sciences, 17th Annual Meeting, New York, January 24–27, 1949, Reprint.) *Aeronautical Engineering Review*, Vol. 8, No. 5, May, 1949, pp. 39, 40. (Summary of a paper.)

With unique metallurgical and design problems of gas-turbine engines, particularly with the combustion and expansion sections, extremely severe testing of aircraft engines to shorten development time and to provide a safety factor under normal conditions should be done with reservations based on the fundamentals of high-temperature metallurgy. When operating temperatures pass about 1,000°F., equal attention must be paid to exact temperature and to time at temperature, as well as to stress. With a thorough investigation of these variables, with proper consideration for the limitations of present alloys, and with a growing background for an understanding of these limitations, a substantial improvement of turboengine performance can be effected without resort to a Utopian material permitting unlimited power and efficiency with a minimum of design effort.

Extrusion of Light Alloys in Germany; Interrogation of K. F. Brauninger. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 1656, Item. No. 21.* 111 pp., diagrs., figs. British Information Services, New York. $3.00.

Aluminum-Clad Products. E. H. Dix, Jr. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 382–402, figs. 26 references. $10.

Manufacture of Super-Purity Aluminum at the Vereinigte Aluminium Werke, Erftwerk, Grevenbroich. L. Evans and W. B. C. Perrycoste. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 1757, Item No. 21.* 52 pp., diagrs., figs. A scrap refining plant using the three-layer electrolytic process.

Report on Visit to Germany and Austria to Investigate Alloys for Use at High Temperature. W. J. Robinson, R. P. Lister, and others. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 396, Item. No. 21.* 76 pp., diagrs., figs. British Information Services, New York. $2.50.

Shortage of Ni, W, Mo, and Cr necessitated the substitution of Mn for Ni in austenitic steels and V for Mo in ferritic steels. This restriction on the development of high-temperature materials stimulated the development of rotor and blade cooling in gas turbines.

The Advantages of Magnesium Extrusions in Design and Assembly. *The Magazine of Magnesium*, February, 1949, pp. 2–5, illus., diagr.

Column Curves for Magnesium-Alloy Sheet. Evan H. Schuette. *Journal of the Aeronautical Sciences*, Vol. 16, No. 5, May, 1949, pp. 301–305, 310, figs. 3 references.

Tests to substantiate predicted strength of columns in compression beyond the elastic range. Flat-end and clamped-end test data for 155 specimens plotted in generalized parameters yielded a curve for the failing stress in terms of the compression yield stress that fitted well with the parabolic curve and the tangent modulus curve. The large amount of scatter evident indicated that neither curve gave accurate prediction for all test results.

Re-Solution Treatment of Aluminium Alloys; A Note on a Method of Improving the Formability of High-Strength Aircraft Alloys. Paul W. Boone. *Aircraft Engineering*, Vol. 21, No. 240, February, 1949, pp. 56, 57, figs.

Light Metal Production and Development for Aircraft, I. G. Farbenindustrie, Bitterfeld. J. D. Wills. *Combined Intelligence Objectives Sub-Committee, Item. No. 21, File No. 20–60,* June, 1945. 11 pp., illus. British Information Services, New York. $0.35.

German magnesium and aluminum production 1934–1944, and a description of the 30,000-ton press at Bitterfeld. This is a summary of development work in high-strength aluminum alloys, corrosion-resistant clad magnesium alloys, and their surface treatment.

Copper and Copper-Alloy Clads. W. L. Keene. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 408–425. $10.

Copper-Base Alloys for Springs. II. Harold C. R. Carlson. *Product Engineering*, Vol. 20, No. 3, March, 1949, pp. 86–91, tables.

The Disordering of β Brass by Cold Work. R. W. K. Honeycombe and W. Boas. *Australian Journal of Scientific Research, Series A—Physical Sciences*, Vol. 1, No. 2, 1948, pp. 190–196. figs. (Reprint.)

The Effect of Alloys on the Properties of Steel; How Molybdenum, Vanadium, Copper, Nickel, Chromium and Other Alloying Elements Affect the Hardenability and Mechanical Properties of Low Alloy Steel. T. W. Merrill. *Product Engineering*, Vol. 20, No. 3, March, 1949, pp. 124–127, figs. 4 references.

Nickel-Clad, Monel-Clad, and Inconel-Clad Steel. W. G. Theisinger. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 426–452, illus., diagrs., figs. $10.

Stainless Clad Steel. Charles A. Scharschu. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 453–462. 38 references. $10.

The Magnetic Properties of Stainless Steel. W. A. Stein. *Electrical Engineering*, Vol. 68, No. 3, March, 1949, p. 204, figs.

Hot-Dipped Aluminum-Coated Steel. B. P. Finkbone. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 403–407, illus. 3 references. $10.

Hardness and Wear Resistance; Hard Surfacing by Fusion Welding. Howard S. Avery. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 483–550, illus., figs. 40 references. $10.

Thermostat Metals. Unto U. Savolainen. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 351–381, diagrs., figs. 19 references. $10.

Sprayed Metal. H. S. Ingham. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 949, pp. 551–572, illus., diagrs., figs. $10.

Silver Solder for High Temperature Service. P. R. Vogt and H. K. Huebotter. U. S. Naval Technical Mission in Europe. *Gt. Brit., British Intelligence Objectives Sub-Committee, Miscellaneous Report No. 94,* October, 1945. 7 pp. A solder 85 per cent silver and 15 per cent manganese developed by Junkers for joining austenitic steels for high-temperature applications such as gas turbines.

NONMETALLIC MATERIALS

Plastics-Based Laminates. R. K. Witt. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 315–350, illus., figs. 23 references. $10.

Dutch Report on German Plastics Industry. II. J. Hoekstra, C. Maters, W. J. L. de Nie, and M. Stel. *Gt. Brit., British Intelligence Objectives Sub-Committee, Miscellaneous Report No. 98.* 35 pp., diagrs. British Information Services, New York. $1.15.

Production methods and techniques. The manufacture, polymerization, treatment, and applications developed by: Dr. F. Raschig, G.m.b.H., Ludwigshafen; Elektrochemische Werke, Rheinfelden; Sphon & Knoll, St. Georgien/Freiburg; I. G. Farben, Gendorf and Ludwigshafen; Aluminum Walzwerke, Forchheim; Dr. Alex. Wacker Ges. fur Elektrochemische Industrie, Burghausen; Kabel- & Metall Werke, Neumeier/Nürnberg, and Rohm & Haas, Darmstadt.

General Survey of Work by Dr. Ryschkewitsch Largely in Field of Ceramics (High-Temperature Ceramics). U.S. War Department. *Gt. Brit., British Intelligence Objectives Sub-Committee, Miscellaneous Report No. 107.* 110 pp., illus., figs. British Information Services, New York. $2.75.

Plastic-Surfaced Plywoods and Their Properties. Norman G. Bull. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp 643–653, illus., figs. $10.

Plywood. N. S. Perkins and David Countryman. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 208–271, illus., diagrs., figs. 12 references. $10.

Rubber Laminates. Walter E. Burton. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 708–741, illus., diagrs., figs. $10.

Composite-Glass Structures. George B. Watkins. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 583–616, illus., diagrs., figs. 4 references. $10.

Transmittance of Near Infrared Energy by Binary Glasses. Jack M. Florence, Francis W. Glaze, Clarence H. Hahner, and Ralph Stair. *U.S., National Bureau of Standards, Journal of Research*, Vol. 41, No. 6, December, 1948, pp. 623–626, figs. 13 references. Available also as *Research Paper No. RP1945*. U.S. Govt. Printing Office, Washington. $0.10.

Adhesives. R. E. Pflaumer. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 89–167, illus., figs. 84 references. $10. A survey of the properties and applications of adhesives of all types.

SANDWICH MATERIALS

The Strength of Laminates and Sandwich Structural Elements. N. J. Hoff. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 6–88, illus., diagrs., figs. 79 references. $10. A résumé of applied mechanics, and current theories of the behavior of laminar and sandwich structural elements under load.

Structural-Sandwich Construction. R. T. Schwartz. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 654–707, figs. 102 references. $10.

Molding Laminates and Sandwich Materials. Charles B. Hemming. *Engineering Laminates*, Albert G. H. Dietz, Editor, New York, John Wiley & Sons, Inc., 1949, pp. 742–773, illus. 37 references. $10.

Meteorology (30)

Mountain-Top Vortices as Causes of Large Errors in Altimeter Heights. F. A. Brooks. *American Meteorological Society, Bulletin*, Vol. 30, No. 2, February, 1949, pp. 39–44, fig. 7 references.

Pressure distributions on an airfoil with flaps measured in flight over mountain peaks show a maximum pressure drop below static pressure of twice the velocity head. When this correction is applied in a 100 m.p.h. wind to a 14,000-ft. mountain, a maximum altimeter-reading error of 700 ft. is indicated. This error does not explain 2,000 to 3,000 ft. errors that have been observed. Pressure drops of this magnitude, however, exist in both tropic cyclones and tornadoes. The pressure drop at the ground surface has an axial connection with the natural low pressure aloft. The strength of the vortex depends on the outside tangential input by the wind, and the superspeed spin outside a vortex depends on radial inflow of air that is discharged along the vortex axis. Procedures are suggested for locating mountain tornadoes.

Radar and the Weather; Applications to the Science of Meteorology. F. E. Jones. *Flight*, Vol. 55, No. 2093, February 3, 1949, pp. 142, 143. (Extended summary of a paper: Radar as an Aid to the Study of the Atmosphere.)

The techniques of microwave radar are being adpated, by the Telecommunications Research Establishment, to the radiosonde for use as a "radarsonde." Actual radar pulses are used as a communications channel, and various methods of achieving the required telemetering accuracy, as the possibility of making an all-electronic unit, are being tried.

Objective Calculations of Divergence, Vertical Velocity and Vorticity. John C. Bellamy. *American Meteorological Society, Bulletin*, Vol. 30, No. 2, February, 1949, pp. 45–49, figs. 2 references.

On the Nature of the General Circulation of the Lower Atmosphere. Carl-Gustaf Rossby. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 16–48, figs., diagrs. 27 references. $7.50. Recent high-altitude observations point to a two-zone circulation system rather than the conventional three-zone description of atmospheric circulation.

New Data on the Lower Stratosphere. B. Gutenberg. *American Meteorological Society, Bulletin*, Vol. 30, No. 2, February, 1949, pp. 62–64, fig. 7 references.

Measurements of temperature, wind, and humidity at altitudes exceeding 30 km. by means of data transmitted by rawinsondes. Heights were computed from pressure and checked by radar tracking.

The Terrestrial Atmosphere Above 300 KM. Lyman Spitzer, Jr. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947*). *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 213–249, tables. $7.50.

Results of a High-Altitude Rawinsonde Flight Over Puerto Rico. D. C. McDowell. *American Meteorological Society Bulletin*, Vol. 30, No. 2, February, 1949, pp. 65, 66, fig.

Scattering in the Atmospheres of the Earth and the Planets. H. C. Van De Hulst. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 49–111, figs., tables. 129 references. $7.50. The optical properties of clear and hazy atmospheres; their measurement and significance.

Seasonal Variations in the Density of the Upper Atmosphere. Fred L. Whipple, Luigi Jacchia, and Zdenek Kopal. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 149–158, figs., tables. $7.50.

The Upper Atmosphere Studied from Rockets. A—Research Progress. Jesse L. Greenstein. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 112–125, figs., diagrs. 18 references. $7.50.

The Upper Atmosphere Studied from Rockets. B—The Ultraviolet Solar Spectrum. H. E. Clearman. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 125–134, figs., diagrs. $7.50. Techniques and results of the research program conducted by the Applied Physics Laboratory of The Johns Hopkins University.

The Upper Atmosphere Studied from Rockets. C—Rocket Sonde Research at the Naval Research Laboratory. E. Durand. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 134–148, figs., illus. $7.50.

The Spectra of the Night Sky and the Aurora. P. Swings. (*Yerkes Obervatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 159–212, figs. $7.50. Contains a description of the emission spectra and evaluation of present data.

Calculation of High Minimum Temperatures. R. Frost. *Gt. Brit., Meteorological Office, Professional Notes No. 95* (Vol. 6, No. 15), 1948, 6 pp. 7 references. British Information Services, New York. $0.10.

Examples of Topographic Convergence in the Equatorial Zone Between 95° E. and 160° E. A. H. Glenn. *American Meteorological Society, Bulletin*, Vol. 30, No. 2, February, 1949, pp. 50–55, figs. 5 references. Methods of forecasting convergence in the low-level circulation which is caused by land masses.

On the Presence of CH_4, N_2O, and NH_3 in the Earth's Atmosphere. M. V. Migeotte. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 284–285. $7.50.

Geological Evidence on the Evolution of the Earth's Atmosphere. Rollin T. Chamberlin. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 250–259. $7.50.

Rare Gases and the Formation of the Earth's Atmosphere. Harrison Brown. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 260–268, figs. $7.50.

The theoretical maximum and minimum amounts of rare gases in the earth and the atomic ratios of these gases to silicon indicate the atmosphere to be of secondary origin and produced as a result of chemical processes subsequent to the formation of the planet.

Selected Topics in the Infrared Spectroscopy of the Solar System. Arthur Adel. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets*. Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 269–283, figs. $7.50. The infrared spectrum affords a tool for the determination of the composition

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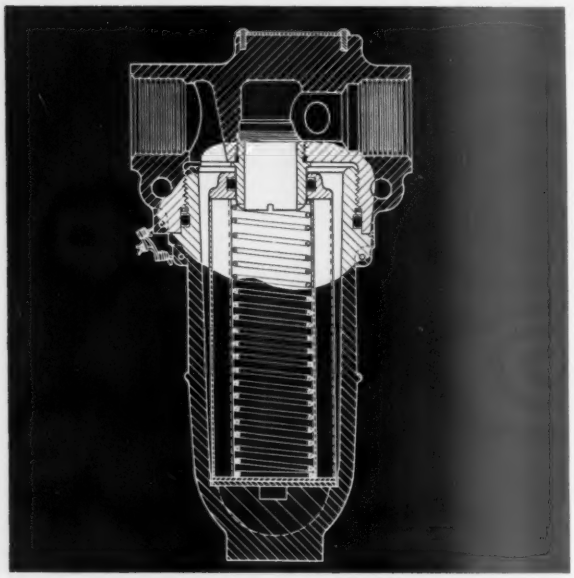

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Survey of Planetary Atmospheres. Gerard P. Kuiper. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets.* Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 304–345, figs. $7.50.

Spectroscopic Observations of the Planets at Mount Wilson. Theodore Dunham, Jr. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets.* Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 286–303, figs. $7.50.

A Capillary Collector for Measuring the Deposition of Water Drops on a Surface Moving Through Clouds. Bernard Vonnegut. *Review of Scientific Instruments,* Vol. 20, No. 2, February, 1949, pp. 110–114, illus., diagrs., figs.

An instrument to evaluate the liquid water content of the atmosphere which measures the amount of water impinging on a small surface area moving through clouds, rain, or snow. It uses capillary phenomena to collect and retain water drops striking a small porous surface. The response rate is sufficiently rapid to measure collection rate over a short interval of time. It has been successfully used in both wind-tunnel and flight tests.

Ionospheric Prediction Aided by Use of Antipodal Points. *U.S., National Bureau of Standards, Technical Report No. 1328,* March, 1949. 5 pp.

Military Aviation (24)

A Post-War Air Force. II. *The Aeroplane,* Vol. 76, No. 1966, February 11, 1949, p. 155, illus. Suggested reorganization of the R.A.F.

The Women's Royal Air Force; Conditions Under Which Women Serve With the R.A.F. *Flight,* Vol. 55, No. 2093, February 3, 1949, p. 145.

Royal Air Force College; Wide Syllabus for Officer-Training To-Day. *Flight,* Vol. 55, No. 2094, February 10, 1949, pp. 159, 160, illus.

Knowledge From the Skies. *The Aeroplane,* Vol. 76, No. 1968, February 25, 1949, pp. 219–221, illus. Diverse activities of the Royal Air Force Central Photographic Establishment at Benson, the equipment used, and film processing techniques.

Cranwell; Air Training-Ground Training. *Flight,* Vol. 55, No. 2095, February 17, 1949, pp. 194–197, illus.

Technical Training Command (R.A.F.). I. C. M. McAlery. *The Aeroplane,* Vol. 76, No. 1962, January 14, 1949, pp. 39–41, illus.

The Canadian Navy Goes Aloft. *Aircraft and Airport,* Vol. 11, No. 2, February, 1949, pp. 10–12, illus.

Navigation (29)

Pressure Comparison Navigation. E. Brook-Williams. *Shell Aviation News,* No. 127, January, 1949, pp. 14–17, figs.

Geostrophic wind components in flight drift are formulated from the relationship of the values at two different points of true air speeds in knots, the sines of the latitudes, and the pressures. The velocity of geostrophic wind is directly proportional to the pressure gradient and inversely proportional to the sine of the latitude. Pressures are determined in relation to absolute altitude, and pressure-altitude charts for the sector traversed enable such an evaluation of cross wind velocity that flights are made without compensating for drift. The course is charted so that the changing direction of the geostrophic wind is self-compensating. Changes of the pressure-altitude relation over the destination, because they affect the velocity of the compensating drift, introduce errors in the true course for a condition of no drift. Single heading operations incorporate only the altitude of a pressure reading at departure and the altitude of the same pressure at the destination. "Best Time" operations select a number of standard tracks so that at least one will approximate a least-time track for a particular flight.

Transverse Navigation; An Alternative to the Grid System. W. A. W. Fox. *Institute of Navigation, Journal,* Vol. 2, No. 1, January, 1949, pp. 25–35, figs.

A system of oblique coordinates in which the equator is assumed to be through the observer's base point and the new north pole to lie on the antimeridian from this starting point at 90° to

it. Positions are expressed in coordinates, relative to this family of meridians and parallels, which take the form of a square grid scarcely distinguishable from the grid used on the various projections of the conventional grid system, except that it is numbered in degrees and minutes instead of miles.

Some Aspects of Flight Planning in Civil Aviation. E. Brook-Williams. *Institute of Navigation, Journal*, Vol. 2, No. 1, January, 1949, pp. 36–42, figs. The use of precomputed data affords greater ease, accuracy, and speed in the production of the flight plan for commercial air-transport flights.

The Reduction of Sights in High Speed Aircraft. P. F. Everitt. *Institute of Navigation, Journal*, Vol. 2, No. 1, January, 1949, pp. 49–52, fig.

Comparison of methods of sighting from a pressurized aircraft with the periscope sextant to find the procedure that requires the least work to be done between the completion of the sight and drawing the position line on the chart because of the high aircraft speeds, and the little, if any, direct view of the sky, which is available.

The Wind Vector in Navigation. II. *Canadian Aviation*, Vol. 22, No. 3, March, 1949, pp. 26–28, 30, figs. The ground-school subjects required for the Canadian private pilot's license; material is based on the Royal Canadian Air Force test CAP-12-A.

Handy "Extra." Walter Untermeyer, Jr. *Skyways*, Vol. 8, No. 4, April, 1949, pp. 23, 58, illus.

The mapigator offers unified course-plotting facilities to personal-plane pilots. Map sections are retained beneath a transparent plastic surface on which are a compass rose, a large rotatable grid disc, a movable wind arrow, and a computer.

Map Reading; Representing the Earth on Paper. I. *Canadian Aviation*, Vol. 22, No. 3, March, 1949, pp. 30, 32, 34, figs.

Personal Flying (42)

Spring Check-Up. *Skyways*, Vol. 8, No. 4, April, 1949, pp. 31, 32, 59, 62, illus. Maintenance tips.

Problems of the Ultra-Light Aeroplane. A. R. Weyl. *Sailplane and Glider*, Vol. 17, No. 2, February, 1949, pp. 38–40.

Lightplane Omni-Range. Lee Irwin. *Skyways*, Vol. 8, No. 4, April, 1949, pp. 18, 19, 52, 53, illus. The Lear Inc. V.H.F. omni-range direction receiving and indicating equipment.

The Future of Our Flying Clubs. R. Vaughan-Fowler. *Indian Skyways*, Vol. 2, No. 12, December, 1948, pp. 35–39, 43, 45.

The increased scope of civil aviation in India enhances the need for training that could be provided by flying clubs. To this end, the clubs require a more definite organization plus increased public and Government support.

Photography (26)

Modern Developments in Aerial Surveying. A. Prain. *Shell Aviation News*, No. 127, January, 1949, pp. 8–11, illus.

Air Force Photography. Amron H. Katz. *Photogrammetric Engineering*, Vol. 14, No. 4, December, 1949, pp. 584–590. The objectives, problems, equipment, and techniques used in the Air Force in reconnaissance, mapping and charting, instrumentation photography, and photographic instrumentation.

The Brock Method. Robert Singleton. *Photogrammetric Engineering*, Vol. 14, No. 4, December, 1948, pp. 538–545, illus., diagr. A rectification process that corrects aerial photographs for tilt in the object and image planes.

New Precision Camera Calibrator. *U.S., National Bureau of Standards, Technical Report No. 1325*, January, 1949. 7 pp., illus.

Calibration of precision airplane-mapping cameras is greatly facilitated by a bank of 25 collimators arranged in the form of a cross, mounted beneath a table, and centered below a large circular opening in the table top. One negative is required, whereas the older method requires four.

An Air Survey Exhibition. *The Engineer*, Vol. 187, No. 4856, February 18, 1949, p. 187, illus. An exhibition of air photographs, survey, and equipment organized by the Hunting Aerosurveys, Ltd.

Power Plants (4)

Luftfahrtforschungsanstalt, Hermann Goring, Braunschweig. H. C. Tett. *Combined Intelligence Objectives Sub-Committee, Item No. 30, File No. 32–89.* 29 pp., illus. British Information Services, New York. $1.15. The Engine Research Division buildings, facilities, personnel, and chemical and combustion research projects.

JET & TURBINE (5)

Research on Aircraft Propulsion Systems. Abe Silverstein. (12th Wright Brothers Lecture.) *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 197–222, Discussion, pp. 222–226, illus., diagrs., figs. 34 references.

A method of analysis that enables aircraft-propulsion systems to be compared on a common basis. By providing an ordered arrangement of the systems according to their use, the areas in which research effort should be expended to increase the performance of the systems are indicated. Analyses of the thrust per unit engine weight, the thrust per unit frontal area, and the thrust delivered per unit rate of fuel consumption, conducted at the Lewis Flight Propulsion Laboratory with various possible types of aircraft propulsion systems, show that performance can be improved by increasing the compression ratios of gas-turbine engines and raising their cycle temperatures, by increasing combustion efficiencies and intensities, and by raising the operating temperatures of heat-resistant materials. Research includes: two- and three-dimensional studies of the flow of compressible and incompressible fluids over isolated airfoils and airfoil cascades; the calculation of pressure distribution over compressor blading; the prediction of blade profiles from specified pressure distributions; wind-tunnel and bench testing of single and multistage compressors; supersonic compressors that utilize compression shocks to obtain high pressure rise; water, air, and film cooling of turbine rotors in order to permit increased turbine inlet temperature; evaluation of heat transfer through a boundary layer; combustion chamber design for higher rates of heat release per unit volume of fuel and higher cycle temperatures and pressures.

Ramjets. *Flight*, Vol. 55, No. 2093, February 3, 1949, pp. 137–141, illus.

Experimental applications of the ram-jet and pulse-jet engines to the N.A.C.A.'s 16-in. ram-jet test missile, the Saenger ram-jet, a North American Mustang with wing-tip mounted ram-jets, McDonnell's ram-jet-driven helicopter, the Marquardt M-14 pulse-jet helicopter, and Martin's Gorgon IV ram-jet missile.

Thrust Stand Devised for Better Accuracy. *Aviation Week*, Vol. 50, No. 6, February 7, 1949, p. 30.

Simultaneous measurement of vertical and horizontal components of thrust and weight of fighter aircraft weighing up to 50,000 lbs. and delivering thrust to 32,000 lbs. permits a complete aircraft-engine calibration. Developed by the Flight Test Division, Air Materiel Command, it may increase the accuracy thrust coefficient measurement to ± 0.1 per cent. The airplane is mounted on a diamond-shaped platform that is supported by four elastic columns and carries a Cox and Stevens weighing cell to measure horizontal static thrust. The test stand is expected to measure thrust coefficients with an accuracy of 0.1 per cent.

Extensive Facilities Required for Developing Aircraft Gas Turbines. E. E. Stoeckly. *Automotive Industries*, Vol. 100, No. 5, March 1, 1949, pp. 27, 58, 59, illus. Full-scale compressor and turbine, and the development of engine accessories and controls at the General Electric Company, Aircraft Gas Turbine Division, Lynn, Mass.

Swivel Probe May Replace Rake in Jet Engine Thrust Measurement. *U.S., Central Air Documents Office (Navy-Air Force), Technical Data Digest*, Vol. 14, No. 5, March 1, 1949, p. 12, illus.

Python Lanc. *Flight*, Vol. 55, No. 2095, February 17, 1949, p. 200, illus. Armstrong Siddeley Python Turboprop power plants installed in a Lancaster.

Design Practices and Construction of Centrifugal Compressors by Leading German Manufacturers. Philipp Goldmann. *U.S., Field Information Agency, Technical, Final Report No. 1152*, May 30, 1947. 36 pp., illus., diagrs., figs. British Information Services, New York. $1.60.

Effects of Several Design Variables on Turbine-Wheel Weight. Vincent L. LaValle and Merle C. Huppert. *U.S., N.A.C.A., Technical Note No. 1814*, February, 1949. 24 pp., figs. 2 references.

The effects of blading aspect ratio and solidity, diameter ratio (the ratio of centrifugal stress at the blade roots to that in the disc), and stress ratio (the ratio of wheel diameter at the blade tip) on the weight of a turbine-wheel model based on the de Laval equation for a disc of uniform strength. A blade is assumed whose cross-sectional area varies linearly from root to tip. From the curves presented it is seen that, for a given annulus area, wheel weight was extremely sensitive to diameter ratio, increasing rapidly in the region of high diameter with an increase in diameter ratio. Increases in stress ratio and in blade solidity increased the total wheel weight, the stress ratio having the greater effect. An increase in blade aspect ratio decreases wheel weight in approximately inverse proportion. Calculated weights agreed satisfactorily with actual weights of some current wheels. A chart showing the variation in total wheel weight with changes in annulus area and in blade length was constructed for obtaining approximate turbine wheel weights for a fixed set for values of disc and blade density, stress ratio, and blade solidity.

The Lubrication of Turbine Engines. II. Ernest E. Turner. *Air World*, Vol. 1, No. 5, January, 1949, pp. 102–107, illus., diagrs.

Lubrication systems of the de Havilland Goblin 2, the Rolls Royce R.B. 37 Derwent 5, the Metrovik F .2, the Bristol Theseus turboprop, and the Whittle W.2.700/III engines. Trends in bearing and gear lubrication are shown by provisional specifications D.Eng.R.D. 2479 and 2480 issued for current and projected designs. A table of typical readings of turbine engine oils is included.

Pneumatic Starter Developed for Turbine Engines. *Product Engineering*, Vol. 20, No. 3, March, 1949, pp. 153–157, illus., diagr.

A self-contained, self-starting system developed by AiResearch Manufacturing Company. A "radial-inward-flow" miniature gas-turbine engine is started by an electric motor, and from it is bled a supply of compressed air that actuates the air-turbine starters of the jet power plant.

RECIPROCATING (6)

Relation Between Spark-Ignition Engine Knock, Detonation Waves, and Autoignition as Shown by High-Speed Photography. Cearcy D. Miller. *U.S., N.A.C.A., Report No. 855*, 1946. 27 pp., illus., diagrs., figs. 68 references.

A critical review of relevant literature and a proposed theory that combines the autoignition and detonation-wave theories. The detonation wave develops in the autoignited or afterburning gases that give rise to comparatively low-pitched heavy knocks. High-pitched pinging knocks are caused by the detonation waves. Five shots of knocking combustion, taken with the N.A.C.A. high-speed motion-picture camera at the rate of 40,000 frames per sec., reveal propagation speeds ranging from 3,250 to more than 5,500 ft. per sec. This range is held to be consistent with the proposed combined theory but not with either the autoignition of detonation-wave theories.

Reports on Visits to Engine Works: M. W. M., Mannheim; Daimler Benz, Rothenbach; Brown Boveri Co., Mannheim. J. Cowderoy. *Combined Intelligence Objectives Sub-Committee, Item No. 26, 29, File No. 26–4.* 7 pp. British Information Services, New York. $0.35.

Stratocruiser Fuel System. *Boeing Service Guide*, No. 16, January, 1949, pp. 2–7, illus., diagrs., cutaway drawing.

Ignition by Means of an Injection of "Ignition Oil." J. R. Parry and C. A. Lindblom. *Combined Intelligence Objectives Sub-Committee, Item No. 19, File No. 29–54*, August 15, 1945. 9 pp., figs. British Information Services, New York. $0.35. Single-cylinder compression-ignition tests at Junkers, Dessau.

ROCKET (4)

Bayerische Motor Werke (BMW). H. A. Liebhafsky, R. H. Norris, and E. H. Hull. *Combined Intelligence Objectives Sub-Committee, Item No. 5, File No. 26–83.* 10 pp., illus. British Information Services, New York. $0.35. Layout and general construction of the liquid-fuel rocket test beds at the BMW, Munich.

The Atomic Rocket Motor. I. Melvin G. Whybra. *Rocketscience*, Vol. 3, No. 1, March, 1949, pp. 7–12, fig. Temperature limitations, working fluid characteristics, and calculated performance of hydrogen used as a working fluid.

Propellers (11)

Steel Propellor Blade Development at V.D.M., Hamburg. L. H. G. Sterne. Gt. Brit., *British Intelligence Objectives Sub-Committee, Final Report No. 321, Item No. 26*, September, 1945. British Information Services, New York. $0.55. Designs of the Vereinigte Deutsche Metallwerke welded hollow steel propeller blades included a hollow shell, ribbed construction, and a type in which the pressure face plate extends half the blade length.

Tests of Contra-Rotating Propellers of $2^1/_2$-ft. Diameter at Positive Pitch on a "Typhoon" Aircraft Model. R. C. Pankhurst, J. N. Veasey, J. R. Greening, and E. M. Love. *Gt. Brit. Aeronautical Research Council, Reports and Memoranda No. 2217*, December, 1945. 28 pp., illus., diagrs., figs. 3 references. British Information Services, New York. $1.60.

Tabulation of overall thrust and the individual torques of two four-bladed counterrotating propellers for a wide range of advance ratio, blade setting, and blade-setting difference for comparison with data for a single eight-bladed propeller over similar ranges of blade setting and advance ratio. At a given advance ratio, the propulsive efficiency of the counterrotating propellers is generally less than that of the front propeller alone and is also less than that of an eight-bladed propeller. Flow over the wings behind the single propellers is turbulent over a much smaller area than it is behind counterrotating propellers, and the measured drag of wings and fuselage with propellers running is correspondingly lower.

Production (36)

Some Developments in Aircraft Production. D. C. Robinson. *Royal Aeronautical Society, Journal*, Vol. 53, No. 457, January, 1949, pp. 39–58, Discussion, pp. 59–66, illus., diagrs., figs.

Aircraft production requires methods that will ensure minimum structural weight, sufficient flexibility to accommodate modifications, and a simultaneous concentration of the maximum number of man-hours in order that the fewest number of aircraft will be worked on at a given time. Handley Page, Ltd., designs major components and subassemblies to be preassembled for subsequent integration in the jig. The accuracy of details and pick-up points is increased by full-scale and photo lofting and by mechanical methods of reproducing dimensions. Economy in production is obtained by the simplification of parts and using rubber-press and stretch-forming to produce stiffening flutes, flanges, depressions, and cutouts in the part in a single operation.

Saab's Materials Laboratory and Its Work. Ivar Weibull. *Saab Sonics*, No. 5, January–March, 1949, pp. 19–23, illus.

Stretch-Wrap Forming; Exploring the Possibilities of the New Hufford A.50 Machine. *Aircraft Production*, Vol. 11, No. 124, February, 1949, pp. 62–64, illus. Method of forming wing tips and engine cowling from 24S-T and 24S-Q sheet, and an analysis of the deformation displayed by the material.

Notes on Martin Manufacturing Methods. H. W. Perry. *Aircraft Engineering*, Vol. 21, No. 240, February, 1949, pp. 39–41, illus., figs. Production methods used to build The Glenn L. Martin Company 2-O-2 air liner without first constructing a prototype.

Giant's Ancillaries; Ground Equipment for the (Bristol) Brabazon: Slinging Gear, Servicing Platforms and Trolleys. *Flight*, Vol. 55, No. 2094, February 10, 1949, pp. 175–177, illus.

Self-Control Saves Hot Air. J. J. Novotny. *The Martin Star*, February, 1949, pp. 8, 19, diagr.

The Electronic Measurement and Control of Heat. III.—Electronics and Welding. John H. Jupe. *Electronic Engineering*, Vol. 21, No. 253, March, 1949, pp. 94–97, diagrs.

Industrial Time Controls. II—Motors and Drive Arrangements. R. H. Mecklenborg. *Product Engineering*, Vol. 20, No. 3, March, 1949, pp. 118–123, illus., diagrs.

Research Facilities (50)

Practical Aerodynamics in France. Jean Brocard and Francois Hussenot. *The Aeroplane*, Vol. 76, No. 1967, February 18, 1949, pp. 187–189, illus., diagr.

Includes development of wind-tunnel techniques to simulate low-flight-speed slipstream conditions with wind-tunnel models, laminar-flow airfoil development, and flight-test methods and programs at Société Nationale du Centre, l'Arsenal de l'Aéro-

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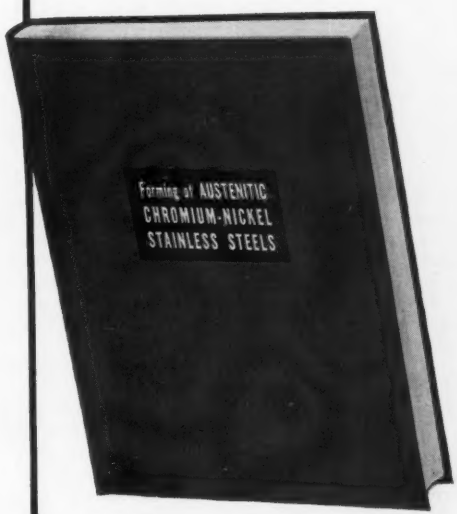

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neutique, l'Institute Aérotechnique de Saint-Cyr., and Centre d'Essais en Vol de Bretigny.

Aeronautische Versuchsanstalt, Goettingen. A. M. O. Smith. *Combined Intelligence Objectives Sub-Committee, Item No. 25, File No. 32–40*, August, 1945. 8 pp. British Information Services, New York. $0.35.

Interrogation of personnel. Subjects included propeller braking, aircraft icing, ceramic rotating-cylinder heat exchanger, cavitation method for determining the optimum shape of bodies at various Mach Numbers, and supersonic diffusors.

Visits to Miscellaneous Aeronautical Establishments in the British Zone. R. D. Hoscooks, J. L. Orr, and J. J. Green. *Gt. Brit., British Intelligence Objectives Sub-Committee, Final Report No. 123, Item Nos. 25, 26, 5.* 15 pp. British Information Services, New York. $0.55.

Water tunnels and towing basins at the Hamburg Schiffau Versuchsanstalt; assembly rig and construction used at Blohm & Voss Aircraft Works, Hamburg; organization, structural testing equipment, and wood-metal bonding research at Focke-Wulf Laboratory, Detmold; and rocket-engine and fuel development at Walther Werke, Kiel.

Reference Literature (47)

The Patent Office Library and Electronics. R. Neumann. *Electronic Engineering*, Vol. 21, No. 252, February, 1949, pp. 52–57, illus., diagr. Shelf arrangement, cataloging, and classification of the book, periodical, and patent literature collections of H.M. Patent Office and Library, London.

Rotating Wing Aircraft (34)

Helicopter Hovering Performance. C. W. Britland. *Royal Aeronautical Society, Journal*, Vol. 53, No. 457, January, 1949, pp. 67–76, figs. 3 references.

An analysis of the primary aerodynamic factors that govern the performance of a hovering helicopter and show the restriction placed on hover performance by forward speed requirements. Graphic presentation of the standard power relationships, developed by Glauert and Squire, show the limits imposed by the onset of blade stalling, by compressibility, and by forward flight upon the choice of aerodynamic and operational parameters. Application of the graphs to the problem of a "flying crane" designed for a forward speed of 50 knots shows that the low speed affords a 30 per cent increase in the pay load that can be carried over the pay load of a similar machine designed for 150 knots forward speed.

Preliminary Development of a Jet-Propelled Helicopter. Roy E. Marquardt. *Aeronautical Engineering Review*, Vol. 8, No. 5, May, 1949, pp. 41–45, illus., diagr., figs. 1 reference.

Development of the ram-jet engine from the first analytical studies through the construction and test of a compressor-burner jet helicopter rotor, the whirl tests of ram-jet and pulse-jet engines, and the construction and flight testing of the M-14 pulse-jet helicopter. Intrinsic advantages of jet-propelled helicopters are the lack of torque reaction and the elimination of the transmission and clutch which make possible an extremely simple inexpensive machine and the light weight of the system. Performance characteristics are compared for four helicopters: ram-jet, pulse-jet, compressor-burner jet, and conventional gear drive. The pulse-jet drive offers the best load-carrying performance.

Stability and Control of Single Rotor Helicopter with Hinged Blades. J. K. Zbrozek. *Aircraft Engineering*, Vol. 21, No. 240, February, 1949, pp. 32–38, figs. 13 references.

The influence of the main design parameters on helicopter stability. Calculations of blade inertia, helicopter moment of inertia, the height of the rotor above the center of gravity, and the offset of the flapping hinges based on the Sikorsky R-4B show that the blade moment of inertia, or Locke's inertia number for the ratio of aerodynamic to inertia forces for a given blade, has the largest influence on helicopter stability and that the influence of the other parameters is a function of the blade inertia number.

Some Aerodynamic Problems of the Helicopter. H. B. Squire. *Helicopter Association of Gt. Britain, Journal*, Vol. 1, No. 3, January-February-March, 1948, pp. 35–48, figs. Rotor-induced velocities caused by the aerodynamic forces on the blades, and the influence of these velocities on the stability of multirotor helicopters.

Power for Helicopters; The Alvis Leonides 23.HM for the Bristol 171: Requirements and Variants. *Flight*, Vol. 55, No. 2094, February 10, 1949, pp. 166–170, illus., diagrs.

Leonides Variants for Helicopters. *The Aeroplane*, Vol. 76, No. 1966, February 11, 1949, pp. 158–161, illus., cutaway drawing. Four adaptations of the Leonides engine to meet air-frame requirements.

Some Work with Rotating-Wing Aircraft. O. L. L. Fitzwilliams. *Helicopter Association of Great Britain, Journal*, Vol. 1, No. 2, October-November-December, 1947, pp. 13–48, illus., diagrs., figs. Design and performance of the Focke Achgelis Fa 330; the Fa 223 lateral-mounted, twin-rotor helicopter for air-sea rescue work; the engine-off landing technique and performance of helicopters.

A Historical Review of Helicopter Development. R. N. Liptrot. *Helicopter Association of Great Britain, Bulletin*, March, 1947, pp. 4–20, illus.

Helicopter Research and Development. C. G. Pullin. *Helicopter Association of Great Britain, Bulletin*, March, 1947, pp. 21–80, illus., diagrs., figs.

Sikorsky Helicopter Development. Igor Sikorsky. *Helicopter Association of Great Britain, Journal*, Vol. 1, No. 2, October-November-December, 1947, pp. 5–12, illus.

Helicopter Rotors. A. McClements. *Helicopter Association of Great Britain, Journal*, Vol. 1, No. 3, January-February-March, 1948, pp. 5–33, figs. A mathematical analysis of the variables affecting the action of the helicopter rotor and the calculated relationships between rotor size, maximum useful load, and percentage useful load.

Some Technical Aspects of W, 9 Development. J. S. Shapiro. *Helicopter Association of Great Britain, Journal*, Vol. 2, No. 1, April-May-June, 1948, pp. 19–39, diagrs., figs.

Automatic Stabilisation of Helicopters. G. J. Sissingh. *Helicopter Association of Great Britain, Journal*, Vol. 2, No. 3, October-November-December, 1948, pp. 4–25, diagrs., figs. 3 references.

A Description of the Bristol Type 171, Mk. 1. Raoul Hafner. *Helicopter Association of Great Britain, Journal*, Vol. 2, No. 1, April-May-June, 1948, pp. 9–18, illus., diagrs.

Helicopter Surprise. William Flynn. *Air Facts*, Vol. 12, No. 3, March 1, 1949, pp. 32, 33, 36–38, illus. United Helicopters, Inc., have used the down-wash of helicopter rotors to dry grape crops and to dry the subgrade prior to road paving.

Crop Spraying in the British Empire. *Helicopter Association of Great Britain, Journal*, Vol. 2, No. 3, October-November-December, 1948, pp. 27–30, illus.

Sciences, General (33)

MATHEMATICS

A Note on Analog Computer Design. J. A. Bronzo and R. G. Cohen. *Review of Scientific Instruments*, Vol. 20, No. 2, February, 1949, pp. 101, 102, 3 references.

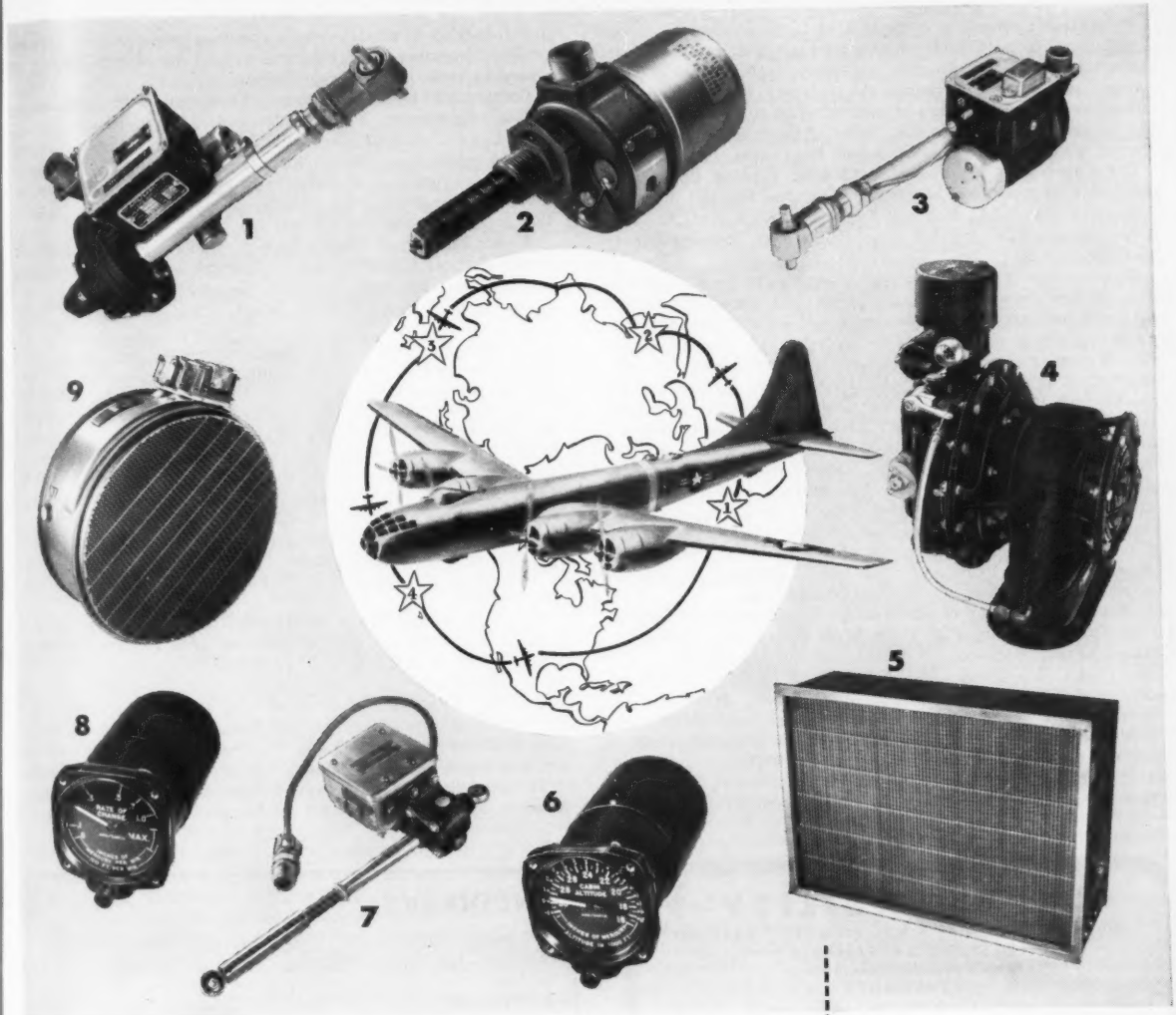
A method for the simplification of computers designed to solve partial differential equations in which the spatial derivatives may be replaced by finite difference expressions. The resulting difference-differential equations are reformulated as a system of linear simultaneous equations by using Laplace transforms. By applying a similarity transformation after introducing matric notation, a new system is obtained which lends itself readily to the construction of an analog. The method is applied to the analog of the equation of the vibrating string with fixed ends.

PHYSICS

Laboratory Absorption Spectra Obtained with Long Paths. G. Herzberg. (*Yerkes Observatory, Fifteenth Annual Symposium, September, 1947.*) *The Atmosphere of the Earth and Planets* Gerard P. Kuiper, Editor. Chicago, University of Chicago Press, 1949, pp. 346–354, figs., tables. $7.50.

Structures (7)

Relaxation Methods Applied to Two Problems of Two-Dimensional Stress Distribution Involving Mixed Boundary Conditions. W. H. Wittrick and W. Howard. *Australian Journal of Scientific Research, Series A—Physical Sciences*, Vol. 1, No. 2. 1948, pp. 135–160, figs. (Reprint.)



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Relaxation methods have been used to determine the stress distributions in both a rectangular and a highly tapered plate under tension when the load is applied through absolutely rigid clamps. Both problems require the treatment of boundary conditions involving the values of both stresses and displacements. The solutions were obtained in terms of displacements and the stresses were subsequently determined from them.

The Lagrangian Multiplier Method of Finding Upper and Lower Limits to Critical Stresses of Clamped Plates. Bernard Budiansky and Pai C. Hu. *U.S., N.A.C.A., Report No. 848*, 1946. 11 pp., figs. 6 references. U.S. Govt. Printing Office, Washington. $0.15.

An approximate solution for true compressive buckling stress of a clamped rectangular plate. The Lagrangian multiplier method is used to compute the upper and lower limits, thereby bracketing the true result. The procedure for obtaining the lower limit is similar to that used by Treffts but inherently converges more quickly. The upper-limit procedure is simpler than the Rayleigh-Ritz method because a simple Fourier expansion may be used instead of the complicated functions otherwise required, and it permits the effects of infinite subsets of expansion terms to enter into the solution. Consequently, a particular stability determinant derived by this method will, in general, yield a closer upper limit than that obtained from a determinant of equal order in the Rayleigh-Ritz method. Lagrangian multipliers are useful in the analysis of vibration frequencies of clamped plates and in the determination of buckling stresses of clamped plates under compression in two directions.

Critical Combinations of Shear and Transverse Direct Stress for an Infinitely Long Flat Plate With Edges Elastically Restrained Against Rotation. S. B. Batdorf and John C. Houbolt. *U.S., N.A.C.A., Report No. 847*, 1946. 8 pp., figs. 9 references. U.S. Govt. Printing Office, Washington. $0.15.

An exact solution and a closely concurring approximate energy solution for the buckling of an infinitely long flat plate under combined shear and transverse direct stress with edges elastically restrained against rotation. An appreciable fraction of the critical stress in pure shear may be applied to the plate without any reduction in the transverse compressive stress necessary to produce buckling. An interaction formula in general use is shown to be decidedly conservative.

Compressive Buckling of Simply Supported Plates with Longitudinal Stiffeners. Paul Seide and Manuel Stein. *U.S., N.A.C.A., Technical Note No. 1825*, March, 1949. 23 pp., figs. 5 references. Charts for analysis of the stability under uniform compression of plates with one, two, three, and an infinite number of identical equally spaced longitudinal stiffeners that have zero torsional stiffness.

Elastic Stability of Simply Supported Flat Rectangular Plates Under Critical Combinations of Transverse Compression and Longitudinal Bending. Norman Grossman. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 272–276, figs. 7 references.

The elastic stability of a simply supported flat rectangular plate subjected to combined bending and compression and investigated theoretically in order to derive the correct interaction curves for various plate aspect ratios. By use of the Rayleigh-Ritz energy method, stability curves were obtained as a function of the length-width ratio. The results indicate that the interaction equation recommended by ANC-5 is incorrect, in that it yields optimistic values for plates of ratio less than 1.05 and conservative values in all other cases.

Observations on the Maximum Average Stress of Flat Plates Buckled in Edge Compression. E. H. Schuette. *U.S., N.A.C.A., Technical Note No. 1625*, February, 1949. 23 pp., figs. 14 references.

Graphical study of the relationship between the maximum average stress and the critical buckling stress in compression of extruded 75S-T, R303-T, and 24S-T aluminum alloys; O-1HTA magnesium alloy; and Z- and channel sections formed from 24S-T and 17S-T aluminum-alloy sheet. In that region where the stresses differ appreciably, the maximum average stress is equal to a constant multiplied by the one-fourth power of the critical stress times the three-fourth power of the compressive yield stress.

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GREAT NECK, LONG ISLAND

Paul Seide and John F. Eppler. *U.S., N.A.C.A., Technical Note No. 1823*, February, 1949, 18 pp., figs. 7 references.

An approximation to the problem of the effect of finite stiffness of ribs and tension surface on the buckling load of the compression surface of a wing. Nondimensional charts relating compressive buckling load, deflectional spring stiffness, and the ratio of the flexural stiffness of the member for the case of equal tension and compression loads are given for tension and compression members having two, three, four, and an infinite number of spans.

Strength Analysis of Stiffened Thick Beam Webs. L. Ross Levin and Charles W. Sandlin, Jr. *U.S., N.A.C.A., Technical Note No. 1820*, March, 1949. 22 pp., figs. 5 references.

A revision and extension of the method presented in *N.A.C.A. T.N. No. 1364* to include beams with ratios of applied shear to buckling shear less than 2.5. Test results for thick-web beams show the accuracy of the revised method to be about the same as the original. The graphs and formulas required for the extension of the method are included.

Shear Stress Concentration and Moment Reduction Factors for Reinforced Monocoque Cylinders Subjected to Concentrated Radial Loads. N. J. Hoff, Vito L. Salerno, and Bruno A. Boley. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 277–295, figs. 11 references.

Diagrams are presented from which the maximum bending moment can be calculated which exists in a ring frame of a circular reinforced monocoque cylinder when subjected to a concentrated radial load. A second set of diagrams is given for determining the maximum shear stress in the sheet covering of the cylinder in the vicinity of such a load. The curves are drawn on the basis of a theory that does not use the simplifying assumptions of the engineering theory of bending. The results of this more accurate theory differ radically from those obtained from the conventional analysis. Reference is made to publications describing experiments that corroborate the theory presented.

Some Explicit Formulae, of Use in the Calculation of Arbitrarily Loaded, Thin-Walled Cylinders. C. B. Biezeno and J. J. Koch. (*Delft, Technische Hoogeschool, Afdeeling Werktuigen Scheepsbouwrunde, Mededeeling No. 153.*) *Netherlands, Nederlandsche Akademie van Wetenschappen, Verhandelingen*, Vol. 44, No. 5, 1941. 10 pp., figs. 2 references. (Reprint.) (In English.)

Collapsing Stresses of Circular Cylinders and Round Tubes. F. J. Plantema. *Netherlands, Nationaal Luchtvaartlaboratorium, Amsterdam, Rapport No. S.280 (Verslagen en Verhandelingen, Deel No. 13)*, 1947. 20 pp., figs. 34 references. (In English.)

Collapsing stresses of circular thin-walled cylinders and thick-walled round tubes of circular cross section under compression, bending, torsion, shear, or under a combination of two or more of these loads. The proposed values are minimum for properly fabricated tubes and are based mainly on test results for small-sized specimens in which the initial deviations from the true cylindrical shape may be relatively larger than in the actual airplane structures. For thin-walled cylinders that collapse in accord with their elastic properties and dimensions and for thick-walled tubes that collapse locally in the plastic region, nondimensional diagrams are given from which the collapsing stresses can be determined.

Torsional Strength of Steel Tubing as Affected by Length. William Le Fevre, Jr. *Product Engineering*, Vol. 20, No. 3, March, 1949, pp. 133–136, illus., diagrs., figs.

The Theory of Beam Columns With Continuous Support Applied to the Problem of Stringer Roll. G. C. Best. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 289–295, figs. 11 references.

A theory of beam columns of constant section with continuous support developed by mathematical procedures that follow those of Timoshenko and others. All deflections are considered to be within the proportional limit. Only the case of a moment at one end is considered because the principle of superposition permits its extension to the case of a moment at each end. Buckling loads are obtained with the criterion that moments become infinite. Results are applied to the problem of stringer roll by considering the vertical portion of the stringer, which is considered as a beam column, to supply continuous support to the flange. An illustrative example is worked out.

Elastic and Plastic Buckling of Simply Supported Metalite Type Sandwich Plates in Compression. Paul Seide and Elbridge Z. Stowell. *U.S., N.A.C.A., Technical Note No. 1822*, February, 1949. 24 pp., figs. 5 references.

Charts for the analysis of the buckling in compression of long sandwich plates having face materials of 24S-T aluminum alloy, 75S-T Alclad aluminum alloy, and stainless steel. Comparison of computed and experimental buckling stresses of square Metalite sandwich plates indicates fair agreement between theory and experiment.

A Method of Assessing Transient Stresses in Photoelastic Substances. John B. Stanton. *Review of Scientific Instruments*, Vol. 20, No. 2, February, 1949, pp. 139, 140, fig.

The techniques of the conventional static photoelastic investigation and the spark shadowgraph that is used in the study of air shock waves combined to produce a photoelastrogram of transient dynamic loading forces. A photograph is obtained of the instantaneous photoelastic pattern with a critically damped spark that gives an exposure time of the order of $^1/_{10}$ microsec. A variable time delay to alter the time between initiation of loading and exposure is provided by a conventional multivibrator circuit built into the shadowgraph.

Photoelastic Stress Determination in Glued Joints. III. *Aero Research Technical Notes, Aero Research Limited, Bulletin No. 73*, January, 1949. 10 pp., illus., figs. 10 references.

A schematic presentation of the photoelasticity apparatus, the determination of stress trajectories with isoclinics, the removal of isoclinics through the use of circular polarized light to obtain a clear picture of the isochromatics, and the evaluation of separate principal stresses observed in polarized light. Applications of photoelastic investigation are shown in the stress pattern presented by a parabolic two-pinned arc loaded eccentrically and in a comparison of experimental and theoretical determination of stresses in glued joints.

Readers' Forum: Complementary Energy Procedure for Flutter Calculations. Eric Reissner. *Journal of the Aeronautical Sciences*, Vol. 16, No. 5, May, 1949, pp. 316, 317.

A Note on Natural Frequencies. M. Z. Krzywoblo ki. *Aircraft Engineering*, Vol. 21, No. 240, February, 1949, pp. 49–54, fig. 7 references

A general sy t of damping is applied to wing flexural and torsional vibration nd the natural frequencies of a wing in both types of vibration are computed. Only the hysteresis of the material was taken into account because the structural damping cannot be taken into account in a general consideration. Conclusions are: (1) Damping has no influence on natural frequency; (2) great damping causes an explosive type of vibration and a decrease of maximum amplitude which increases the danger that the pilot may not notice the moment at which the resonance point would be reached; (3) materials having great damping may not be desirable in aircraft construction. Metals have more advantages than wood because metals have smaller damping parameters.

The Calculation of Coupled Modes of Vibration by the Stodola Method. Henry E. Fettis. *Journal of the Aeronautical Sciences*, Vol. 16, No. 5, May 1949, pp. 259–271, figs., tables. 2 references.

The advantageous use of the Stodola method of calculating natural modes of vibration as applied to coupled bending-torsion modes. Two current methods of computing coupled modes are: (1) the Rayleigh-Ritz method in which the uncoupled modes are first computed and then used as coordinates, with which the coupled modes may be approximated, and (2) the influence coefficient method. The advantage of the Stodola method over the Rayleigh-Ritz method lies in that it involves only slightly more labor than would be required to compute the uncoupled modes by the same method and also in the fact that the exact mode shape is found rather than an approximation of undetermined accuracy. Further, the necessity of solving the determinantal equation is done away with, so that any additional work over that required to compute the uncoupled modes is more than made up for. The advantage over the influence coefficient method is that the work can be performed by a technically unskilled operator, whereas the influence coefficient method requires knowledge of matrix algebra. Also, the resulting matrix will be of the order $2n$ for n stations on the wing, so that for large wings it may be necessary to employ mechanical means to evaluate the results.

Some Effects of Structural Deformation in Airplane Design. Albert Epstein. *Aero Digest*, Vol. 58, No. 2, February, 1949, pp. 28–30, 102, 104, 106, illus., figs. 10 references.

The relative positions of the aerodynamic forces acting on the wing, tail surface, and fuselage of an airplane determine the tor-

sional and bending deflections that, at different flight speeds, alter the effective twist of the aerodynamic surfaces with respect to the air stream. The relation of wash-in and elastic instability, wash-out and decrease of aileron effectiveness, the effect of fuselage bending on tail surface effectiveness, and the effects of surface distortion and structural deformation are examined to show their effects on loads, performance, control, and stability of an aircraft with unswept aerodynamic surfaces. Methods of calculating these aeroelastic effects are extended in order to determine the stability and control characteristics of swept-wing aircraft.

Aircraft Weight and Balance. II. M. C. Anderson and J. W. Rocke. *Aero Digest*, Vol. 58, No. 2, February, 1949, pp. 54, 55, 58, 59, 118–120, 122, illus., figs.

The resolution of moments of aircraft components fore and aft of the datum line and overall weight determine the location of the center of gravity. After equipment changes have been made, a new center of gravity is computed by adding the initial and additional weights and dividing the total moment by the new weight. Weight-and-balance problems do not involve any more than finding the horizontal arms of the weights, total moments, and, finally, the center of gravity. Net changes of loading moments about this point will cause a shift in the location of center of gravity. If the new location is beyond limits, ballast is used for compensation. To complete a weight-and-balance check, a mechanic must be familiar with two C.A.A. forms, the Aircraft Operations Record, Form 309, and the Repair and Alteration Form, No. 337. Loading schedules are changed by weight and balance operations only in accordance with bulletins from the manufacturers or the C.A.A.

Frocke Wulf Structural Laboratory, Detmold. A. W. Hotson. *Combined Intelligence Objectives Sub-Committee, Item No. 25, File No. 26-8.* 36 pp., illus. British Information Services, New York. $1.00. Description of static and dynamic testing machines, and testing procedures for components of an entire aircraft.

Thermodynamics (18)

Methods of Minimizing Errors in the Measurement of High Temperatures in Gases. E. Marston Moffatt. *Instruments*, Vol. 22, No. 2, February, 1949, pp. 122–132, diagrs., figs.

Radiation errors depend on the temperature difference between the gas and the walls. Other conditions that tend to increase the error are high absolute temperature, very high and very low velocities, and low pressures. Calculated correction factors for errors can often be so high as to make them valueless. The best experimental technique is to use probes with the accuracy required for the job and use their readings without any correction.

An Investigation of Aircraft Heaters XXX—Nocturnal Irradiation as a Function of Altitude and Its Use in Determination of Heat Requirements of Aircraft. L. M. K. Boelter, H. Popendiek, G. Young, and J. R. Andersen. *U.S., N.A.C.A., Technical Note No. 1454*, January, 1949. 56 pp., figs., tables. 13 references.

An extension of Andersen's method of determining nocturnal irradiation at the ground to determine nocturnal irradiation as a function of altitude and a more complete heat-rate balance on airplanes. Nocturnal radiation—which includes radiation from all radiating atmospheric gases, radiation upward from the earth, and radiation from the dust in the atmosphere—decreases greatly as a function of altitude. Nocturnal-irradiation data for several sets of meteorological data are given to establish possible limits.

Readers' Forum: Porous Cooling. Lester Lees. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, p. 255.

Water-Borne Aircraft (21)

Some Measurements of Pressure Over a Vee-Shape When Dropped Into Water. E. T. Jones. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2312*, March, 1935. 24 pp., diagrs., figs. 5 references. British Information Services, New York. $1.45.

Diaphragms were fitted into the side of a vee-frame that was dropped into water, and the motions of the diaphragms were recorded and compared. Results confirmed the shape of the pressure distribution diagrams over the hull bottom which are shown in *R. & M. 1638*. The maximum intensity of the pressure close to the keel exceeds that toward the chine, and the pressure wave travels up the sides of the hull at about the same rate as the hull descends. Tests conducted with diaphragms of different stiffness indicate that the normal force on the hull bottom depends, to a small extent, on the rigidity of the bottom. The more rigid the construction, the greater will be the normal force for a given set of conditions.

XP5M-1 (Martin) Getting Navy Test. *The Martin Star*, February, 1949, p. 7, illus.

Effect of Longitudinal Steps on Skipping Characteristics of PB2Y-6 Flying Boat. R. B. Clark and W. T. Sparrow. *U.S., N.A.C.A., Technical Note No. 1824*, January, 1949. 9 pp., illus., diagrs., figs. 4 references.

Landing tests were made to determine the effect of production step vents and forebody longitudinal steps on skipping. Skipping occurred at higher landing trims without either step vents or longitudinal steps. The step vents alleviated skipping somewhat but were not large enough to be completely effective. The longitudinal steps caused a marked decrease in skipping which was not further affected by the addition of step ventilation.

A Statistical Study of Wave Conditions at Four Open-Sea Localities in the North Pacific Ocean. L. A. Harney, J. F. T. Saur, Jr., and A. R. Robinson. *U.S., N.A.C.A., Technical Note No. 1493*, January, 1949. 28 pp., figs. 6 references.

A study of wave conditions in four representative open-sea localities in the Pacific Ocean was undertaken to investigate the following characteristics of the sea and wind which are considered of primary importance in the structural design of flying boats and seaplanes: (a) wave height and frequency of occurrence, (b) wave length-height ratio and frequency of occurrence, (c) wave velocity and its relation to wave lengths, (d) wind velocity, and (e) wave shape. Percentage frequencies of wave height ratios have been calculated by use of weather maps and methods developed for forecasting sea and swell. Comparison between computed and observed heights was found to be satisfactory.

Wind Tunnels (17)

Experiments on Laminar-Flow Aerofoil EQH 1260 in the William Froude National Tank and the 13 ft. x 9 ft. and the 9 ft. x 7 ft. Wind Tunnels at the National Physical Laboratory. A. Fage and W. S. Walker. *Gt. Brit., Aeronautical Research Council, Reports and Memoranda No. 2165*, January, 1942. 19 pp., illus., figs. 14 references. British Information Services, New York. $1.15.

To determine whether the flow conditions are sufficiently steady for the properties of laminar flow airfoils to be investigated at high Reynolds Numbers. Both the 13- by 9-ft. and the 9- by 7-ft. tunnels are suitable up to about 5,000,000 R. Disturbances at the Froude tank, caused by surface wave and eddy formation, require an experimental technique that minimizes their importance.

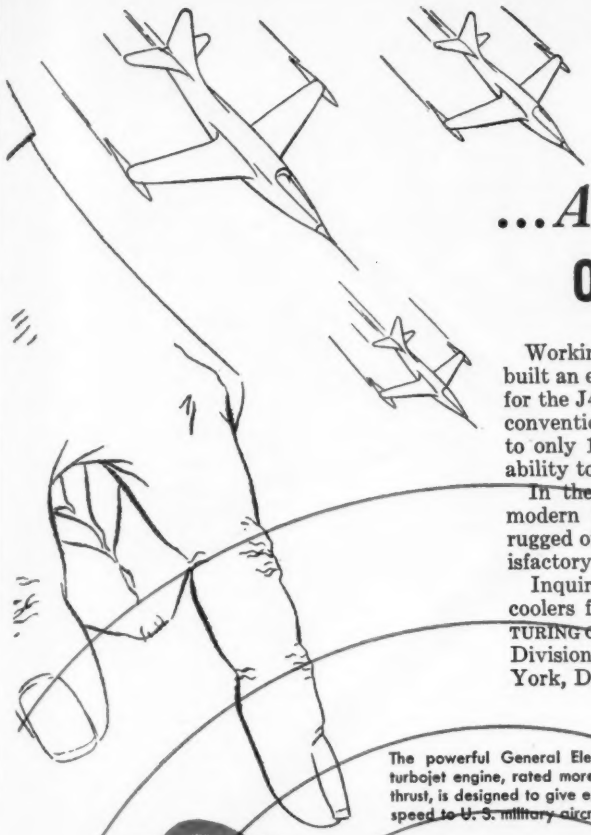
The Effect of Wall Interference Upon the Aerodynamic Characteristics of an Airfoil Spanning a Closed-Throat Circular Wind Tunnel. Walter G. Vincenti and Donald J. Graham. *U.S., N.A.C.A., Report No. 849*, 1946. 22 pp., figs. 18 references. U.S. Govt. Printing Office, Washington. $0.20.

Characteristics of an airfoil in the tunnel at subsonic speeds are corrected to free air conditions. Tests of an NACA 4412 airfoil at low Mach Numbers for two ratios of airfoil chord to tunnel diameter demonstrate the validity of analytical results. At high Mach Numbers, the maximum permissible chord-diameter ratios are expected to decrease as the Mach Numbers increase. At low Mach Numbers, the spanwise lift distribution on an airfoil spanning a closed-throat circular tunnel is essentially constant, except at angles of attack in the immediate vicinity of stall. The correction equations cannot apply at or in the immediate vicinity of the choking Mach Numbers. This number can be estimated by means of equations given in the report.

Wind-Tunnel Wall Corrections for Wing-Body Combinations. C. B. Smith. *Journal of the Aeronautical Sciences*, Vol. 16, No. 4, April, 1949, pp. 237–242, diagrs., figs. 1 reference.

By examining the simplest case of a wing in combination with a circular body in a closed circular tunnel, corrections are deduced for a series of wing-body-tunnel configurations. The results, in general, indicate a difference of sufficient magnitude to cast considerable doubt on the practice of applying wing-alone correc-

(*Continued on page 77*)



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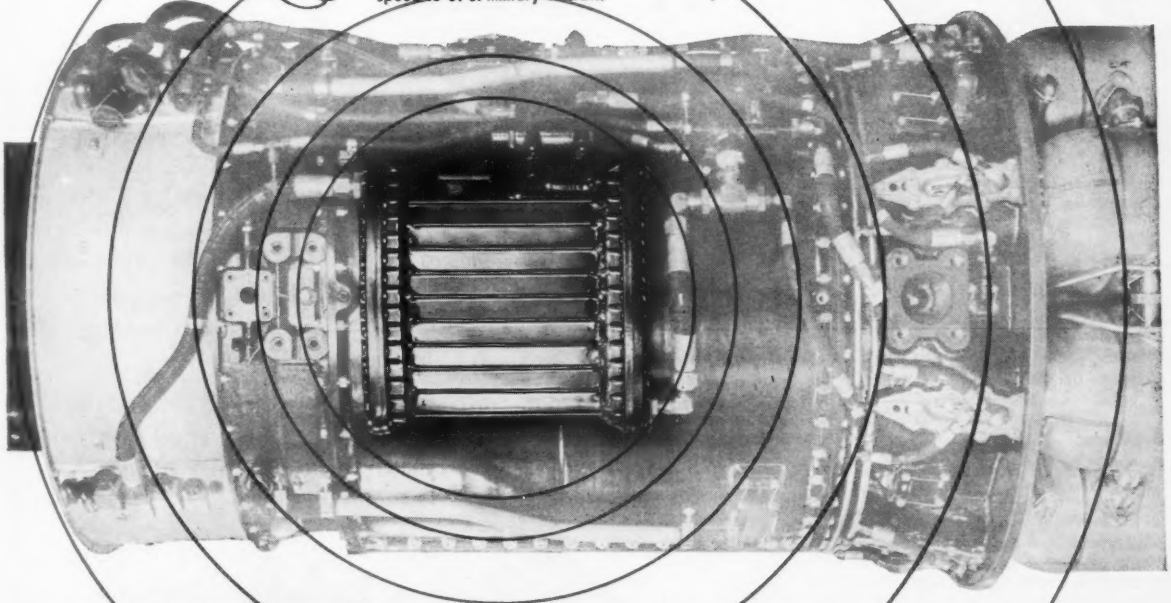

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Aeronautical Reviews

Books

Aircraft Maintenance and Repair

By The Technical Development Staff of Northrop Aeronautical Institute, Charles Edward Chapel, Chief Editor. New York, McGraw-Hill Book Company, 1949. 444 pp., illus. $6.00.

When the late war took most of the younger skilled technical workers or potential trainees out of industry into the armed forces, the expansion of industrial production required the employment of many types of workers, some of limited technical aptitudes. This led to the growth of simplified and elaborate pictorial systems of teaching and well-illustrated textbooks. The highly mechanized air, military, and naval services also required that most of their personnel become proficient technicians.

Out of this situation has come the elementary textbook that resembles a machine service manual. It is so simple that any intelligent person can understand it and yet so full of information that skilled technicians can profit by it. *Aircraft Maintenance and Repair* is a book of this kind. As is stated in the preface, it is intended for the aircraft mechanic who can profit by it in class, in home study, on the job, and in preparation for general certification examinations required by factory and Government standards. Engineering and executive personnel, however, could also find this book useful. It is a large book, set in clear easily read type and broken up in sections, paragraphs, and subparagraphs, two columns to a page, so that each topic with its title stands clearly by itself and can be picked up for quick reference. The book is profusely illustrated by halftones, working drawings, diagrams, sketches, tables, and charts.

The following chapter headings will indicate the scope of the book: Fundamentals of Aircraft Hydraulics; Flow Control Valves; Pressure Control Valves; Hydraulic Systems; Hydraulic Brake Actuating Systems; Landing Gear; Heat Treating and Inspection of Metals; Aircraft Gas Welding Equipment; Gas Welding Technique; Gas Welding Technique for Ferrous Metals; How to Weld Aluminum Alloys; Construction and Repair by Welding; Aircraft Sheet-Metal Tools, Machines and Methods; Aircraft Layout Work; Aircraft Riveting; Aircraft Woodworking Tools and Machines; Glue, Screws, and Nails for Aircraft Woodworking; Construction and Repair of Wooden Aircraft; Fabric Covering, Dope and Its Applications; Aircraft Wire and Cable Work; Assembly and Rigging; Weight, Balance and Loading.

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Statements and opinions expressed in Book Reviews are to be understood as individual expressions and not necessarily those of the Institute.

Book Notes

AIR TRANSPORTATION

Aspects of United States Participation in International Civil Aviation. (Publication 3209.) Washington, U.S. Department of State, Division of Publications, 1949. 118 pp.

Articles are reprinted here from the Department of State Bulletin, 1944–1948, on international public and private law, agreements, and international air facilities, including weather stations and radio aids to navigation. The greater part of the material deals with discussions at sessions of the International Civil Aviation Organization.

AIRPLANE DESIGN

Airplanes and Elementary Engineering. H. G. Wintersteen. Scranton, Pa., International Textbook Company, 1948. 86, 59, 66, 46 pp., illus. $3.85.

The first half of this book deals with the airplane and its parts describing types of aircraft, control devices, wing, fuselage and control considerations, landing gears, floats, and hulls. Glossaries of aircraft terms and of terms relating to floats or hulls are included. Continuing the discussion on the airplane and its parts, details of construction are taken up, including materials, fastening devices, wing members, spars, ribs, power-plant installations, and various smaller parts. Elementary aeronautical engineering follows this discussion. Physical principles and their application, stresses and loads, determination of design loads, stability and balance, shop layout problems, and drawings and blueprints are included. The final section deals with airplane hydraulic systems.

ATOMIC ENERGY

Must We Hide? R. E. Lapp. Cambridge, Mass., Addison-Wesley Press, Inc., 1949. 182 pp., illus. $3.00.

This is a competent review of the published facts about the effectiveness of the atomic bomb, with well-reasoned estimates of its possible role in warfare, and of the best defenses against it.

While the author does not minimize its effects, he does not consider the bomb to be an "absolute" weapon. For example, persons who were in underground shelters at Hiroshima and Nagasaki were, on the whole, little harmed. Prompt bathing will remove most radioactive material and greatly reduce its effectiveness. Thermal radiation can be nullified at 1,000 ft. by 32 in. of concrete and requires no protection at 5,000 ft. Gamma rays travel with the speed of light and may still be lethal at 4,000 ft., but gamma rays that go into the cloud are likely to have nuisance value only. Delivery of the bomb will depend, for at least five years, upon advanced designs of conventional aircraft, which are capable of long-range flight at high altitude. Dispersal of centers of population and industrial concentrations, on a voluntary basis, is the best defense against the bomb and is the author's principal thesis. Early warning is the essential factor in any defense system. A stock pile of atomic bombs is not comparable to other armaments, in that the bombs are readily convertible to peacetime uses in atomic power plants. The author, who was connected with the Manhattan Project and is an authority on nuclear energy, has worked on problems of radiological safety and is now executive director of the committee on atomic energy, Research and Development Board, National Military Establishment.

ELECTRONICS

Radio Wave Propagation, Consolidated Summary Technical Report of the Committee on Propagation of the National Defense Research Committee. Chas. R. Burrows, Chairman. Stephen S. Attwood, Editor. New York, Academic Press, Inc., 1949. 548 pp., illus., diagrs. $8.80.

The three volumes of the Committee's report were originally issued in a limited edition and subsequently declassified from security restrictions. This volume contains all the technical and experimental information of the original reports, omitting administrative and historical details. The opening critical overall view of the technical developments in the study of trospheric propagation includes the general theory of standard and nonstandard propagation, the results of transmission experiments carried out in various parts of the world, and a résumé of the meteorological factors affecting propagation. The meteorological theory, equipment, and forecasting techniques enabling prediction of radio performance from earlier meteorological measurements are taken up next, followed by discussions of reflection coefficients, dielectric constant, absorption and scattering, and echoes and targets. The final part deals with problems of radio-wave propagation in the standard atmosphere at frequencies above 30 mc., in the range of operation

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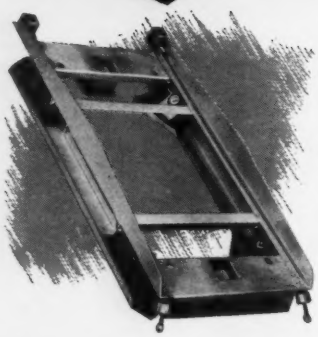

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LORD
Vibration Control Systems

of most radars and an increasing number of communication circuits. This part, supplemented by material in the first two parts, can be used as a textbook emphasizing practical applications of the theory, for men with college training in radio, physics, or electrical engineering. Bibliographies are included giving more than 1,000 references to original reports.

Electronic Time Measurements. Edited by Britton Chance, Robert I. Hulsizer, Edward F. MacNichol, Jr., and Frederick C. Williams. (Massachusetts Institute of Technology, Radiation Laboratory Series No. 20.) New York, McGraw-Hill Book Company, Inc., 1949. 538 pp., illus., diagrs. $7.00.

The object of this book is to present methods of approach to problems of time and distance measurement by manual and automatic means and the practical circuits employed for these purposes. The discussion opens with a survey of techniques for radio distance and speed measurements, continuing with basic techniques and methods in pulse-time-measurement, including the generation of fixed and movable timing markers and their applications to manual and automatic time measurements. It continues with the use of these techniques for precision data transmission and for the relaying of the radar Plan Position Indicator to remote points. A discussion of the use of supersonic delay devices for the cancellation of recurrent wave forms concludes the book. Footnote references are included throughout, and a glossary is provided.

Elements of Radio. Abraham Marcus and William Marcus. 2nd Ed. New York, Prentice-Hall, Inc., 1948. 751 pp., diagrs. $4.25.

This new edition of a standard book for schools and for home study reflects the standardization in symbols and terminology achieved since its first publication in 1943 and includes new material on radar and television, as well as a number of changes in the text. The chapter on direction finding is replaced by a chapter on modern radio receivers. The basic method of presentation in the first edition has been retained, proceeding from the simple and concrete to the complex—for example, from the simple crystal receiver through various levels to the more advanced sets, in much the same manner as the science of radio actually developed.

Photoelectricity and Its Application. V. K. Zworykin and E. G. Ramberg. New York, John Wiley & Sons, Inc., 1949. 494 pp., illus., diagrs. $7.50.

This is a completely new treatment of the field discussed in *Photocells and Their Application*, by Zworykin and Wilson, last revised in 1934. Such developments as the antimony-cesium phototube, the high-gain secondary-emission multiplier, the image tube, and electronic television are included in this volume, which is about twice the size of its predecessor. The properties, preparation, and use of photoelectric devices are presented, the last half of the book being devoted to applications. References are given at the ends of chapters, and author and subject indexes are provided. The senior author is Director of Electronic Research, Radio Corporation of America; Dr. Ramberg is Research Physicist, R.C.A. Laboratories Division, Princeton, N. J.

FLIGHT SAFETY AND RESCUE

National Fire Protection Association, Advance Reports to the 53rd Annual Meeting, May 16–19, 1949. Boston, Mass., The National Fire Protection Association, 1949. 278 pp., diagrs.

Includes the report of the Committee on Aviation and Airport Fire Protection, in three divisions: I. Aircraft Rescue and Fire-Fighting Equipment for Airports; II. Standard Operating Procedures, Aircraft Rescue and Fire Fighting; III. Fire Hazards of Static Electricity in Aircraft Operations and Maintenance. The reports of 25 committees are contained in the volume, presenting tentative codes for fire-fighting procedures, equipment, and storage of flammable and combustible materials.

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HISTORY

The Second World War, 1939–45; a Strategical and Tactical History. J. F. C. Fuller. New York, Duell, Sloan & Pearce, 1949. 431 pp., maps. $5.00.

General Fuller brings to the task of presenting the strategy and tactics of World War II a wide knowledge of the development of military tactics and a thorough acquaintance with documents and published sources. His appraisals of the initial overextension of the Japanese and the eventual overextension of the Germans show once again how narrow the margin of Allied victory was, and his judgments on such matters as the concept of strategic bombing, the revolutionary nature of the missile weapons, and the possibilities resulting from the mobilization of science for war are deserving of careful study. This British review of the strategy and tactics of the war is more than a convenient reference. Because of its carefully considered interpretations, it should be studied by anyone concerned with the future, as well as with the past.

METEOROLOGY

Centennial Symposia, December, 1946. Contributions on Intersellar Matter, Electronic and Computational Devices, Eclipsing Binaries, The Gaseous Envelope of the Earth. (Harvard Observatory Monographs, No. 7). Cambridge, Mass., Harvard Observatory, 1948. 385 pp., illus., diagrs. $5.00.

Partial contents: Evolution and Physics of Solid Particles, by H. C. van de Hulst; The Adaptation of Photoelectric Devices to the Properties of the Electron, by Gerald E. Kron; Infrared Detectors and Their Astronomical Applications, by A. E. Whitford; Electronic and Electromagnetic Measuring, Computing, and Recording Devices, by W. J. Eckert; The Solar Corona and Ultraviolet Radiation, by Leo Goldberg and Donald H. Menzel; Solar Activity, by Walter Orr Roberts; The Ionosphere, by J. H. Dellinger; Earth-Sun Relationships, by Donald H. Menzel; The Sun and Conditions in the Upper Atmosphere, by Harlan T. Stetson; Meteors and the Upper Atmosphere, by Fred L. Whipple; Solar Activity, the Ozone Layer and the Lower Atmosphere, by B. Haurwitz; Solar Activity and the General Circulation of the Lower Atmosphere, by H. C. Willett.

REFERENCE LITERATURE

International Industry Yearbook; the Encyclopedia of Industrial Progress, 1948. Lloyd J. Hughlett, editor. New York, Kristen-Browne Publishing Company, Inc., 1948. 414 pp., illus., diagrs. $10.

This is a well-planned and executed volume, opening with a review of world industry by the editor and giving the available data on basic industrial production for 20 principal industrial nations, including Russia. Reviews of industrial progress in 1947 and a few years previous by authorities in 26 fields make up the greater part of the book, which covers industrial research, air conditioning, refrigeration and heating, chemicals, compressed air, electronics, ceramics, illumination, materials handling, physical metallurgy, metalworking, industrial packaging, paint, varnish and lacquer, petroleum, plastics, rubber, and standardization. Lists of references accompany each review. Aircraft applications are mentioned in some instances.

SCIENCES, GENERAL

MATHEMATICS

Numerical Calculus; Approximations, Interpolation, Finite Differences, Numerical Integration, and Curve Fitting. William Edmund Milne. Princeton, N.J., Princeton University Press, 1949. 393 pp. $3.75. (Reproduced from typewritten copy.)

(*Continued on page 77*)

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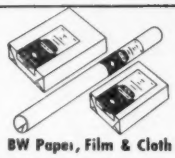

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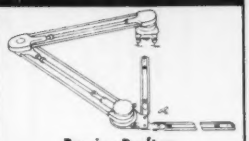

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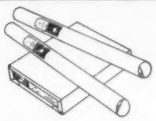

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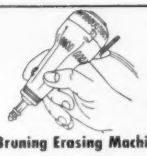

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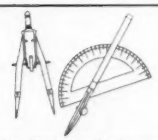

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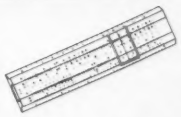

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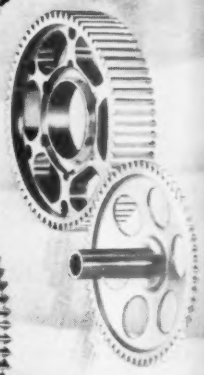

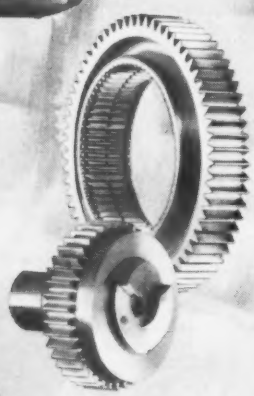

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I.A.S. Sections

(*Continued from page 13*)

Chicago Section

Alden Mooers, *Secretary*

At the April 6 meeting, which was a joint meeting with the Mechanics Colloquium of the Illinois Institute of Technology, members heard Dr. N. O. Mykelstad, Professor of Theoretical and Applied Mechanics, University of Illinois, on the topic of "Aircraft Flutter Problems."

Cleveland-Akron Section

S. Doree Black, *Secretary*

With more than 100 persons present, A. C. Ballauer, Project Engineer, McDonnell Aircraft Corporation, spoke on the subject of the jet-propelled helicopter, illustrated by a color film, at the April 25 meeting.

Columbus Section

Harold E. Heberding, *Acting Secretary*

Acting Secretary Heberding presided at the April 20 meeting at which Carroll J. Peirce, Ohio State University Professor, made the principal speech. Mr. Peirce's subject was "The Problem of Escape from the Earth."

Hagerstown Section

James M. Crook, *Secretary*

"Guided Missiles" was the talk given at the March 29 meeting. The speaker, W. W. Bender, Chief of Electro-Mechanical Section, The Glenn L. Martin Company, was introduced by Chairman Herman Wieben.

▸ **Flying Test Bed**—Chief subject of the talk was the Gorgon IV, designed, built, and flown by the Martin company for the Navy. The Gorgon IV, Bender said, was designed primarily not as a guided missile but as a flying test bed on which to test ram-jet engines. However, it was completely radio-controlled and incorporated means by which it could be landed with a parachute, thus recovering the missile and the recorded test data.

Philadelphia Section

J. Albert Ray, *Secretary*

Members attending the April 26 meeting heard John Keto, Chief, Radiation Laboratory, Wright Field, on the subject of "Radar—Its Past and Future."

▸ **Radar Operation**—In his talk, Mr. Keto first showed a short film that explained the operation of radar both from the ground and in the airplane for the interception of enemy aircraft. With the use of slides, the various aeronautical military uses of radar were discussed with brief outlines given on their development.

One of the more significant uses in this connection was radar for sea-searching of enemy submarines off our East Coast and the auxiliary bombing computer attachments that were developed to permit efficient bombing of the subs after sighting them.

▸ **Space Problem**—The myriad of problems involved in the development of radar and other instruments brought on especially by lack of space inside present-day aircraft, and the aerodynamic requirements prohibiting outside antennas and large protuberances were discussed. The advances in miniaturization of instruments parts and flush-mounting of antennas were illustrated with a display of actual components.

In conclusion, the various uses of radar, not necessarily military, were commented upon, topped off with a film of a GCA landing.

Toronto Section

F. H. Brame, *Secretary*

The Section held its May 10 meeting in the University of Toronto, with Vice-Chairman C. V. Lindow presiding.

Chief speaker was Dr. L. M. Pidgeon, Head of the Department of Metallurgy, University of Toronto, who presented a talk on "Some Properties and Uses of Light Metals."

A short business session at the conclusion of the talk discussed proposals of affiliation of a local branch of the Royal Aeronautical Society.

Student Branches

Cal-Aero Technical Institute

Chairman Albert Amaya presided at the April 19 meeting at which he announced the semiannual I.A.S. Student Branch Scholastic Award was to be made and called upon John L. Dickonson to discuss the basis on which the award is made.

Presentation of the Scholastic Award was made to William M. Woollen by Hugh G. Nicholson, Jr.

The incoming Chairman, A. C. Reid, was introduced by Mr. Amaya. The new Chairman introduced the incoming Vice-Chairman, L. K. Groharing. Lloyd G. Cowan, new Secretary-Treasurer, was absent from the meeting.

Guest speaker Dr. Arthur L. Klein, Professor of Physics, California Institute of Technology, gave a talk on "Aircraft Fitting Design and Analysis."

Carnegie Institute of Technology

A lecture by I. A. Marsh, Instructor in Mechanical Engineering, Carnegie Institute, dealt with production engineering in aeronautics. Organization of this type of engineering was broken down into its component groups, and the duties of each were briefly described. Fifteen were present at the meeting on April 26.

The list of groups discussed included fuselage or hull, engine, armament, landing gear, hydraulic, electric, wing, and tail. In addition, stress, vibration, and testing subjects were presented.

University of Florida

An open meeting for everyone interested was held on April 4 with the result that attendance was close to 100. Chairman Charles E. Jordan presided.

The Chairman introduced Eastern Air Lines' Jacksonville Traffic Manager Engle, who gave a short introductory talk preceding the showing of the film *Air Power Is Peace Power*.

An informal discussion with both Mr. Engle and Eastern's Chief Pilot, Capt. Seymour, was held after the film's showing.

Massachusetts Institute of Technology

An enlightening talk on the organization, propeller projects, and engineering work at the Propeller Division, Curtiss-Wright Corporation, was given by J. William Long, Administrative Engineer of the division, at the April 27 meeting.

Chairman Charles E. Richbourg presided, with 21 persons present.

University of Michigan

At the April 18 meeting, W. Z. Stepniewski, Chief Aerodynamicist, Piasecki Helicopter Corporation, talked on job opportunities at Piasecki and on the future role of the helicopter, both for commercial and military uses.

April 22 was the bi-annual Engineering Open House, in which all departments of the school set up dis-

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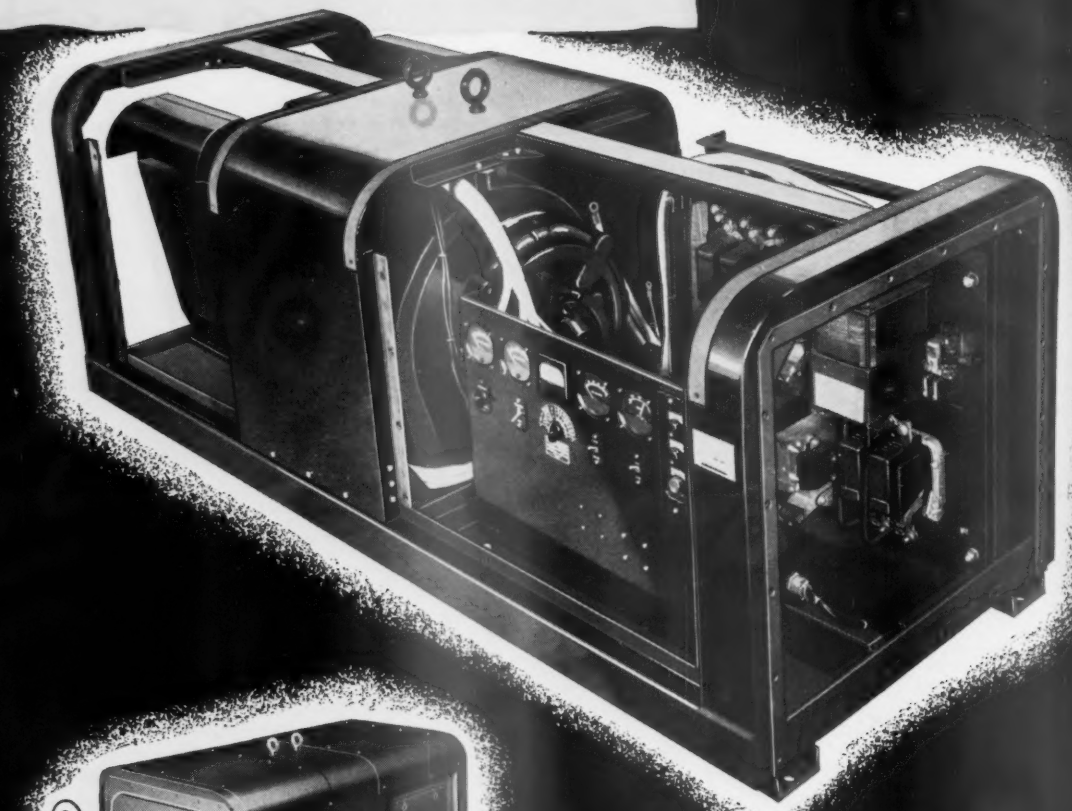

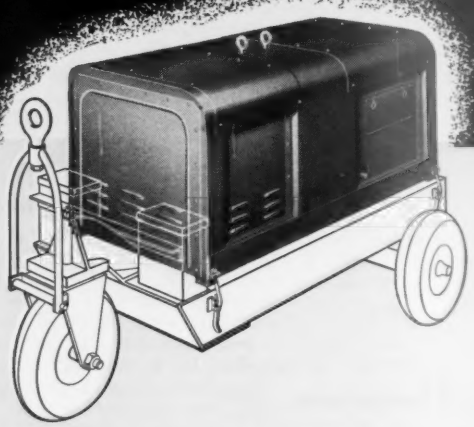

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plays to show other students and visitors the type of work being done in the engineering school.

I.A.S. members have formed a softball team that is challenging other organizations and departments. At the annual picnic, the players hope to beat their professors and still pass their courses.

Mississippi State College

Dr. August Raspet, Project Leader of the Sailplane Project, Mississippi State, gave a summary of the work accomplished in the sailplane project and of future plans.

The project, Dr. Raspet said, is divided at present into four phases: (1) laminar airfoil behavior of a Pratt-Read sailplane to determine the influence of a noise field on the laminar boundary (this will test the validity of wind-tunnel tests on laminar airfoils made at the high noise level of current tunnels); (2) aerodynamic skid control to coordinate automatically and accurately the rudder of a sailplane or airplane; (3) bird aerodynamics, a study of flight characteristics of large soaring land and sea birds; (4) convection structure. The determination of the exact nature of the airflow in a convective cell in the atmosphere and the measurement of the physical parameters influencing the flow are the principal goals of this research.

At present it is hoped that a total of twelve sailplanes will be available later this year for the project.

Northrop Aeronautical Institute

A combined Dinner and Technical Session were held April 7 with E. C. Frost, Department Manager of Preliminary Design, Lockheed Aircraft Corporation, as speaker of the evening.

Subject of the talk was "Aerial Highways" in which Mr. Frost discussed the external and internal inertia loads of aircraft encountered in flight. A series of slides was shown with the talk, followed by a technicolor film on the *P-80 Power on Test*, in which the cause of tailpipe failures in flight was investigated.

At the May 5 meeting, R. E. Root, Administrative Assistant to the Project Executive Engineer, Northrop Aircraft, gave a talk on "Development of the Guided Missile," in which he discussed the different types of missiles and their respective developments up to date.

Oregon State College

An election of new officers was held at the May 4 meeting with the following results: Chairman, Elliot R. Buxton; Business Secretary, Alden R. Wright; Corresponding Secretary, Dale R. Leisy; Treasurer, Alan H. Lee. Office of Vice-Chairman is to be filled next year by a member of the Junior Class.

A film, *Structures*, was shown which concerned the North American B-25.

Parks College of Aeronautical Technology

New officers elected at the March 17 meeting are as follows: Chairman, George Cote; Vice-Chairman, John Jolda; Treasurer, Joseph Eisley; Recording Secretary, Robert Riley; Corresponding Secretary, Donald Grande.

Purdue University

C. J. Hansen, Assistant Chief Engineer, North American Aviation, Inc., was the chief speaker at the April 5 meeting. Chairman William Wiard presided at the meeting attended by 200.

The speaker discussed engineering phases involved in the building and testing of the B-45 jet bomber.

Tri-State College

Professor Frank Acton, Department of Aeronautical Engineering, spoke on the "Possibility of Employment in Other Fields" at the April 20 meeting. He stressed three points: knowledge, ingenuity, and ability to work.

University of Tulsa

The Chairman, Charles Kelley Barton, gave a talk on "Aircraft Flaps" at the April 28 meeting. In his review of the use of flaps on aircraft, emphasis was placed on the development of the Fowler flap and the improved aerodynamic features that are obtained in its use.

Two films were shown: *General Sheet Metal Practice* and *This Is Aluminum.*

Virginia Polytechnic Institute

Films were shown at the April 27 meeting, Cleo Boothe Wood, Chairman, presiding.

University of Virginia

New officers elected at the May 12 meeting were as follows: Chairman, Robert J. Tapscott; Vice-Chairman, B. H. Stephenson; Secretary, L. R. Lewis; Treasurer, P. M. Lewis.

After the election of officers, Dr. E. L. Corey, of the University Medical School, spoke on "Engineering Problems of Aviation Medicine."

University of Washington

"The Hoppi-Copter," subject of a talk by Horace Pentecost, inventor of the small helicopter machine, was the chief feature at the April 18 meeting.

Mr. Pentecost spoke about the development and performance of the Hoppi-Copter, which is being tested and further developed by the British government. The British, he said, expect to market the Hoppi-Copter in the U.S. commercially, as well as to use it for military purposes.

A short color film showing the Hoppi-Copter in flight was shown.

University of Wichita

At the April 20 meeting new officers were elected: Chairman, Dan Carl; Vice-Chairman, Carl Fowler; Secretary, Edward King; and Treasurer, Bill Howard. Elton Rowley, Chief of Boeing Flight Testing, spoke on the "Boeing B-47."

Members Elected

The following applicants for membership or applicants for change of previous grades have been admitted since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Ballhaus, William Francis, Ph.D. (Aerodynamics and Math.), Design Specialist, Douglas Aircraft Co., Inc. (El Segundo).

Liepmann, Hans Wolfgang, Ph.D., Associate Prof. of Aeronautics, California Institute of Technology.

Malina, Frank Joseph, Ph.D. in Ae.E., Deputy Head, Dept. of Natural Sciences, United Nations Educational, Scientific & Cultural Organization.

Marquardt, Roy E., M.S., President, Marquardt Aircraft Co.

Masefield, Peter Gordon, M.A. (Engrg.), Deputy Chief Executive, British European Airways.

Schairer, George Swift, M.S., Staff Engineer—Aerodynamics & Power Plant, Boeing Airplane Co. (Seattle).

Sieradzki, Henry Joseph, Sr., B.S. in Ae.E., Landing Gear Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Sokol, Max, B.S. Ae.E. & B.S.M.E., Project Engineer, Standard Aero. Indexing System, Institute of the Aero. Sciences, Inc.

Yuan, Shao Wen, Ph.D., Asso. Prof., Polytechnic Institute of Brooklyn.

Elected to MEMBER Grade

Aderton, Thomas R., Power Plant Group Engineer, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Donaldson, John D., M.A., Aero. Engineer, Aerodynamics, Consolidated Vultee Aircraft Corp.

Eastman, Donald Roger, Jr., B.S. in Ae.E., Executive Engineer with Committee on Aeronautics, Research & Development Board (Washington, D.C).

Figley, Richard E., B.M.E., Lt. Col., U.S.M.C.; Bureau of Aeronautics General Representative, Western District.

Gitt, Michael Allen, Capt. & Airline Pilot, Colonial Airlines, Inc.

Heimburger, Douglas C., B.S. in Physics, Engineering Test Pilot, Boeing Airplane Co. (Wichita).

Larratt, Arthur E., B.S., Staff Design Engineer, The Glenn L. Martin Co.

Lawbaugh, A. LaVielle, Chief of Design, General Tire & Rubber Co.

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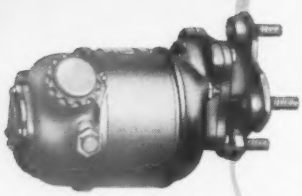

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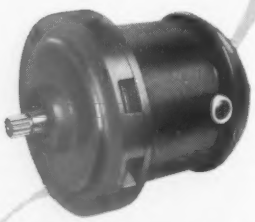

Rugged construction is a major factor in the reliability of this motor widely used in the field of mechanized equipment.

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Libove, Charles, B. of Civil Engineering, Aero. Research Scientist, N.A.C.A. (Langley Air Force Base).

Livingston, Chester Gordon, B.S. in Ae.E., Lt. Comdr., U.S.N.R.; Project Test Pilot, Flight Test Div., N.A.T.C., N.A.S. (Patuxent River).

Lober, George W., B.S. in E.E., Asst. District Mgr., Sales Engineering, Northwestern District Office, Sperry Gyroscope Co. Div., The Sperry Corp.

Luhouse, John E., Draftsman, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Olow, Bengt R., Civil Ing., Flight Test Engineer, SAAB Aircraft Co.

Riparbelli, Carlo, Dr. in Ae.E., Asst Prof., Cornell University.

Ruhsenberger, John Roger, M.S., Capt., U.S.N.; Commanding Officer & Dir., Special Devices Center (Port Washington).

Shepperd, Lewis A., M.D., Military & Commercial Pilot; Doctor—Certified Flight Surgeon, Columbia-Presbyterian Medical Center.

Spengler, Kenneth C., A.B., Executive Secretary, American Meteorological Society.

Stevenson, R. E., Designer "A," Power Plant, Consolidated Vultee Aircraft Corp.

Wills, Ernest William Leonard, Sr. Lecturer of Aero. Sciences, Air Service Training, Air Universities (England).

Wolf, S. K., M.S., Asst. General Commercial Dir., International Standard Electric Corp.

Wu, Chung Hua, Dr. of Sc., Aero. Research Scientist P-5, Lewis Flight Propulsion Lab., N.A.C.A.

Transferred to MEMBER Grade

Anderson, Robert R., B. of Ae.E., Structures Engineer, United Helicopters, Inc.

Blake, Ralph L., B.Ae.E., Development Engineer, Air Turbine Div., AiResearch Mfg. Co.

Bruno, Joseph F., M. of Ae.E., Liaison Engineer, Bureau of Aeronautics, Navy Dept.

Callaghan, Edmund E., A.E., Aero. Engineer & Research Scientist, Lewis Flight Propulsion Lab., N.A.C.A.

Graves, William Edward, B.S. in Ae.E., Loads Analyst, North American Aviation, Inc.

Hetzel, Eustace P., M.S., Asst. Chief of Flight Test, Northrop Aircraft, Inc.

Preston, Thomas George, Chief Engineer, Prenco Progress & Engineering Corp.

Saslaw, Martin David, A.A. in Ae.E., Assoc. Prof., Spartan College of Aero. Engineering.

Elected to Associate Member Grade

Strobhar, Frank E., A.B., Mgr., Aviation Dept., Dayton Chamber of Commerce.

Transferred to Associate Member Grade

Maitan, Joseph J., B.S., Controller, Institute of the Aero. Sciences, Inc.

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Brookes, Hazel F., Weight Engineer, Saunders-Roe, Ltd.

Livingston, William Harold, Lt.-Naval Aviator, U.S.N.

Luther, Kenneth R., Engineering Draftsman "A," North American Aviation, Inc.

Maultsby, Charles Wayne, Engineering Draftsman "B," Northrop Aircraft, Inc.

Nay, Harvey O., M.S. (Aero.), Aerodynamicist, Douglas Aircraft Co., Inc. (El Segundo).

Noton, Bryan Rex, Apprentice Designer, Bristol Aeroplane Co.

Occo, John Charles, Chief Draughtsman, Australian National Airways, Ltd.

Packard, Howard S., Lt.—Naval Aviator & Student Test Pilot, U.S.N. (Patuxent River).

Persons, Martha Day, Engineering Draftsman, Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Powell, Frederick D., A.B., Dynamics Engineer, Bell Aircraft Corp.

Transferred to Technical Member Grade

Aker, Robert Lee, B.S., Design Engineer, Pines Mfg. Co.

Bloom, Harold L., B.S. in M.E. (Aero.), Aero. Research Scientist P-2, Lewis Flight Propulsion Lab., N.A.C.A.

Clark, Cleophas M., A.A., Engineering Draftsman, NEPA Div., Fairchild Engine & Airplane Corp.

Colditz, Eugene F., B.S. Ae.E., Lab. Technician, Allison Div., General Motors Corp.

Dahlof, James E., B. of A.E., Engineer, Structural Design Dept., Chance Vought Aircraft Div., United Aircraft Corp.

Danyow, Sidney Edward, B.S. in Ae.E., Jr. Engineer, Aerodynamics Preliminary Design, Boeing Airplane Co. (Seattle).

Dock, Edward L., B.Ae.E., Aero. Research, Development & Design Engineer, U.S.A.F. (Wright-Patterson Air Force Base).

Doornink, Paul W., B.S. in Ae.E.

Duggins, William E., B.S.Ae.E., Engineer, Cessna Aircraft Co.

Duron, Paul P.

Edwardson, Richard J., Engineering Illustrator, Goodyear Aircraft Corp.

Farnsworth, Franklin L., B.S.M.E. (Aero.), Jr. Engineer, Boeing Airplane Co.

Finkelman, Seymour, B. of Ae.E.

Fonda, John F., Student, Fenn College.

Freund, Ernest E., B.S

Gillham, Hugh I., B.S. in Ae.E., Engineering Draftsman "A," Fuselage Design Group, Douglas Aircraft Co., Inc. (El Segundo).

Gluyas, George L., B. of Ae.E., Engineering Asst., Aerodynamics, Lockheed Aircraft Corp.

Grey, I. Richard, B.Ae.E., Test Engineer, Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp.

Griffin, John R., Aero. Engineer, Link Aviation, Inc.

Holliday, Bobbie B., Lab. Mechanic, Consolidated Vultee Aircraft Corp. (Texas).

Hoyt, Richard L.

Jaffe, David H., B.S., Asst. Instructor in Aircraft Power Plants, University of Illinois.

Jennings, David C., B. of Ae.E., Jr. Aerodynamicist, Hamilton Standard Propellers Div., United Aircraft Corp.

Johnson, Ralph S., Jr., Sr. Draftsman, Goodyear Aircraft Corp.

Keilp, John P., Sr. Draftsman, Goodyear Aircraft Corp.

Kent, Holger C., B. of Ae.Sc., "B" Draftsman, North American Aviation, Inc.

Kirby, Thomas B.

Knutson, Donald C., B. of Ae.E., Test Pilot, Production Flight Test Dept., Boeing Airplane Co. (Seattle).

Komiske, Charles A., B.S.

Kuehn, Donald M., B.Ae.E., Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Landry, John V., B.S. in Ae.E., Engineering Draftsman "B," North American Aviation, Inc.

Lawton, William J., Jr., B.S. in Ae.E., Mathematician "A," Performance Section, Aerodynamics Group, Douglas Aircraft Co., Inc. (Santa Monica).

Lee, Harry S., B. of Ae.E., Jr. Engineer, Airplane Div., Curtiss-Wright Corp.

Manty, Reino J.

Marz, George J., A.A. in Ae.E.

McMurray, Betty, B.S. in Ae.E., Technical Writer, Chance Vought Aircraft Div., United Aircraft Corp.

Messerschmitt, Richard C., B.S. in Engineering, Research Asst., Aero. Lab., Princeton University.

Minnich, Otto J., Jr., B.S., Draftsman "A," Douglas Aircraft Co., Inc. (El Segundo).

Munoz, Miguel A., Student Engineer, Academy of Aeronautics.

Murphy, Joseph E., B.S.E., Graduate Student, Aero. Engineering, University of Michigan.

Neal, Donald M., B. of Ae.E., Aerodynamicist, Airplane Div., Curtiss-Wright Corp.

Nelson, Robert L.

Nielsen, Charles Jr., B.Ae.E., Jr. Scientist, Dept. of Aero. Engineering, Rosemount Research Center, University of Minnesota.

Noe, Robert C., B.Ae.E., Stress Analyst, Grumman Aircraft Engineering Corp.

Oechsle, Albert K., B.S. in M.E.

O'Toole, Joseph P., B.S. Ae.E.

Peck, William B., B.Ae.E., Jr. Engineer, Piasecki Helicopter Corp.

Peterson, Richard S., B.S. in Ae.E., Jr. Engineer "B," Drafting & Design, Boeing Airplane Co. (Seattle).

Richardson, Franklin G., B.S. in Ae.E., Draftsman "C," Fairchild Aircraft Div., Fairchild Engine & Airplane Corp.

Rogers, Robert H., B.S. in M.E. (Aero.), Draftsman, Beech Aircraft Corp.

Sengir, Charles F., Jr., B. of Ae.E., Instructor, Dept. of Aero. Engineering, University of Minnesota.

Siegel, Keeve M., B.S. in Physics, Research Assoc., University of Michigan Aero. Research Center.

Swingle, Charles E., B.S. in Ae.E., Weight Control Engineer, Consolidated Vultee Aircraft Corp. (Ft. Worth).

Telles, Sanford, B.Ae.E., Stress Analyst "B," North American Aviation, Inc.

Tribley, Arthur C., A.A. in Ae.E., Sr. Draftsman, Goodyear Aircraft Corp.

Van Heyningen, Vernon F., B.S., Graduate Student. Aero. Engineering, University of Illinois.

Ward, Ralph W., Jr., B.S., Engineering Trainee, Chance Vought Aircraft Div., United Aircraft Corp. (Dallas).

Winters, Russ B.

Wood, William R., B.S. Ae.E., Tool Designer, Chance Vought Aircraft Div., United Aircraft Corp.

Woodward, James R., Draftsman, Rohr Aircraft Corp.

Woollen, William M., Engineering Student, Cal-Aero Technical Institute.

Zabinsky, Joseph M., B.S. in Ae.E., Research Asst., University of Illinois.

Zimmerman, H. Jim, Engineering Student, Spartan School of Aeronautics.

Zynda, Earl A., Engineering Draftsman "B," Armament Div., Hughes Aircraft Co.

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Since the Post Office Department does not as a rule forward magazines to forwarding addresses, it is important that the Institute be notified of changes in address 30 days in advance of publishing date to ensure receipt of every issue of the *Journal and Review.*

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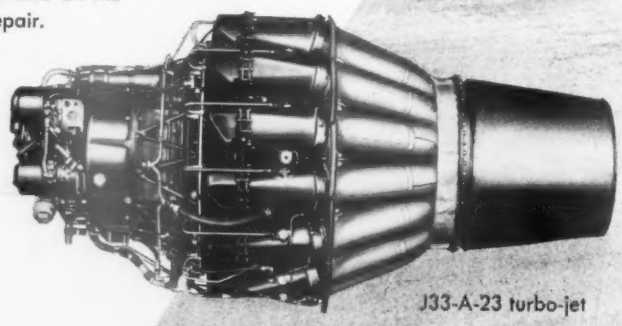

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WANTED

Aerodynamicists, Senior—For advanced problems in aerodynamics of airplanes and missiles. Inquiry should include comprehensive experience résumé. Address: Manager, Engineering Personnel, Bell Aircraft Corporation, P.O. Box 1, Buffalo 5, N.Y.

Assistant or Associate Professor—To teach undergraduate and graduate aerodynamics, preliminary design, and allied courses. Prefer man with advanced degree in aeronautical engineering and practical experience in aerodynamics or design. Salary dependent upon qualifications. Aeronautical Engineering Department, University of Kansas, Lawrence, Kan.

Airmen and Technical Personnel—Positions open in West Coast scheduled helicopter operation. **Airmen**—flight, administrative, and technical research, with or without helicopter training. Multiengined time required. **Technical**—maintenance, radio, engineering, and inspection. Power-plant and machining background important. Employment contingent upon comprehensive training program. Apply by mail only to Los Angeles Airways, Inc., 5901 West Imperial Highway, Los Angeles 45, Calif.

Aeronautical Design Engineers—For production work on the B-47 Jet bomber and modification of B-29 and B-50 Bombers. Graduate engineers, 5 years or more of heavy aircraft design experience. Direct replies to Engineering Personnel Representative, Boeing Airplane Company, Wichita Division, Wichita 1, Kan.

Structures Engineer, Senior—For advanced problems in load criteria, design, and analysis. Inquiry should include comprehensive experience résumé. Address: Manager, Engineering Personnel, Bell Aircraft Corporation, P. O. Box 1, Buffalo 5, N.Y.

996. Helicopter Engineer—Experience in helicopter aerodynamics and stress analysis required. Project Engineering position open. Administrative experience desired.

988. Teacher—Large southern university has opening for an Aerodynamicist. Must have advanced degree; industrial experience desired. Rank and salary depend on qualifications of applicant.

969. Professor of Aerodynamics—To handle senior and graduate work in aerodynamics. Should have outstanding theoretical ability plus practical wind-tunnel experience in both subsonic and supersonic speeds. Position with one of the Big Nine Midwest Universities. Advanced degrees necessary.

968. Associate or Full Professor—Now permanent position available with leading midwestern state university to teach and develop courses in the general field of airplane dynamics, such as vibrations, flutter, aeroelasticity, etc., and to direct graduate research in these fields. Advanced degrees with practical industrial experience necessary. Attractive salary. Effective September 1, 1949.

964. Assistant Professor of Aeronautical Engineering—Equipped in particular to teach theory of elasticity of the graduate level. Duties begin September, 1949. Location Philadelphia. Apply giving education, teaching, and other experience, plus references and small photograph.

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12. Aeronautical Executive—Twenty years' experience, with exceptional knowledge of the aircraft and related industries. His promotional and administrative "know-how" and his ability to get things done should make him a valuable asset to an aircraft manufacturer, accessory manufacturer, or air line in general management work, particularly in connection with sales or contract development, public relations, industry relations, or Government relations. In recent position as an officer of a highly regarded national aeronautical organization, has contributed greatly to its phenomenally rapid growth over the last 8½ years. Has voluntarily negotiated his separation with his coofficers and board of directors in order to seek a more challenging opportunity where he can apply his talents to still greater productiveness. In excellent health, has traveled widely throughout the country, and enjoys extensive contacts with the leaders in industry and in important Government circles.

11. European Professor of Aeronautical and Mechanical Engineering—Experience in airplane design in industry, in wind-tunnel work in research institute, and in teaching mechanics, aerodynamics, and airplane structures; would accept Assistant Professorship as first position in U.S. Spent 6 months at California Institute of Technology earlier on fellowship.

10. Research Associate—Ph.D. in Applied Mechanics, June, 1949, with 11 years' industrial experience in analysis, design, and production; 3 years' part-time teaching and analytical and experimental research in jet propulsion, compressible flow, and airplane structures. Desires Associate Professorship with research possibilities.

999. Public Relations Counsel—Wishes to handle public relations and representation work for aviation organization in Utica, N.Y., and vicinity. Many years' experience in civic affairs, publicity, and promotion. Former Rehabilitation Chairman of the N.Y. State Veterans of World War II. Aircraft overhaul experience in Navy, Air Force, and Coast Guard for 9 years. Fifteen years' experience in local public relations work.

998. Administrative Assistant or Aeronautical Engineer—Bachelor Aeronautical Engineering, Georgia Tech. 1946, and Master of Business Administration, Cornell University, 1949. Age 23; married. One year as research engineer with N.A.C.A., including tunnel operation and technical report writing. General administrative experience as Navy Ensign. Available immediately.

997. Engineer—Pilot—B.S.M.E. (Aeronautical Major), Purdue. Registered M.E. (California). Resident Los Angeles 11 years. Thirteen years' experience, 5 years in aircraft. Naval pilot, 4 years. Represent Eastern manufacturer in Southern California. Salary or commission.

995. Engineering Teacher—M.S. in Mathematics (physics minor); B.S. in Mechanical Engineering (structures option); B.S. in Education. Six years' teaching experience in thermodynamics hydraulics, hydraulics laboratory, strength of materials, applied mechanics (statics and dynamics), aircraft stress analysis, and engineering physics. Three years with major airplane company in mechanical equipment unit and stress analysis unit. Good progress in work and studies. Phi Kappa Phi while earning engineering degree. Desires teaching position in a progressive college or university. Prefers teaching any of the above. Courses on indeterminate structures, refrigeration, or internal combustion engines. Will locate anywhere but prefers the Western states, Texas, or Florida. Housing essential. A detailed outline of education and experience will be sent upon request.

994. Aerodynamicist—Desires to obtain position in the field of aerodynamic research or development or a related field that will offer administrative and technical responsibility. Preference is for nonroutine work involving new ideas and requiring imagination and initiative. The position must hold opportunity for advancement and furtherance of personal education and experience in this field. Can offer the following background: age 29; education, B.Ae.E. and M.S. in Aeronautical Engineering; experience, 5 years' work in the aeronautical field covering supervision of modification of naval aircraft, directing test and development of droppable aircraft fuel tanks, stress analysis, development of aluminum automobile trailers, instructor in aircraft engines, designer of transonic wind-tunnel models, balances, and associated equipment, and project engineer on guided missile and ballistic aerodynamic research. Most of these assignments have involved supervision responsibilities and coordination with outside activities. Registered Professional Engineer.

993. Assistant Airport Manager—B.S. in Aeronautical Technology, University of Alabama. Four years' pilot in the U.S.M.C.R. Commercial pilot license. Flight instructor rating. Experience as civilian flight instructor. Experience as planning engineer with large aircraft company. Desires position as assistant airport manager or administrative air-line work.

992. Aerodynamicist—B.Sc. in Mathematics and Physics, M.S. in Aero. E. Age 25; single. Two and one-half years' experience with major aircraft company, responsible for variety of research and design aerodynamics on transonic and supersonic projects, including supervision of low-speed and high-speed wind-tunnel programs, analysis of high-speed wind-tunnel and Flight-test data, conduct of general design studies, etc. Desires teaching position, with opportunity for research. Location open.

990. Mechanical Engineer—B.S. and M.S. in Mechanical Engineering. Five and one-half years' experience in aircraft and aircraft components, operation, maintenance, design, modification, and conversion. Three and one-half years of this supervising 30 engineers with a major air line as Manager of Engineering. Three and one-quarter

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years' experience in research, development, and engine testing of fuels and lubricants with major oil company. Latter 2½ years supervising 5 engineers. Three-quarters year's experience in structural research and testing for major aircraft manufacturer. Two years of college teaching experience. Experience qualifies for design, research, development, administration and provides excellent background for sales engineering. Must locate in or about Philadelphia.

989. Associate Professor—Aeronautical or Mechanical Department. Doctor's Degree, 10 years' industrial experience in supervisory capacity. Teaching experience in thermodynamics, fluid mechanics, stress analysis, aircraft structures, theory of machines, etc. Wants similar position with university in New York Metropolitan Area or vicinity.

987. Aeronautical Engineer—Bachelor of Aeronautical Engineering, Polytechnic Institute of Brooklyn. Active member of Officers' Reserve Corps (1st Lt.). Was navigator during war; possesses pilot's license. Four years' sales experience, some drafting and Lab. Technician experience. Desires position leading to sales engineering or field representation. Single; age 25; car; free to travel.

986. Aeronautical Engineer—B.S.; M.S.; will receive Ph.D. in Aero. Eng. in Summer of 1949. Eight years' experience teaching airplane maintenance; airplane design; introductory aerodynamics; airplane static test; high-altitude problems; aircraft engines; physics of the atmosphere. Has had practical as well as administrative experience. Desires permanent teaching position but will consider industry offers.

984. Aeronautical Engineer—M.S., University of Minnesota. Two years' teaching experience. Young; ambitious. Will consider teaching, research, or production engineering position.

983. Aeronautical Engineer—Recently completed 3 years as Operations Engineer with major U.S. air line handling weight control, interior layout design, performance calculation, etc. Broad background including 2 years of aeronautical engineering training, 2 years of toolmaking, 15 months as Air Force Maintenance Engineering Officer and B-29 Flight Engineer Instructor, including 700 hours' flying time. Holds current C.A.A. Aircraft and Engine Mechanics license. Desires to locate in northern New Jersey area.

982. Equipment and Aerodynamics Engineer—B.S.M.E. degree, 1941 (Aero-Mechanical). Five years' experience with leading airplane manufacturer. Sound experience in design, development, and testing automatic-air operated regulators and control devices. Extensive experience in altitude equipment test laboratory. Familiar with high-speed and wind-tunnel test methods and reduction of test data. Three years' industrial experience, including design and development of heavy machinery and industrial evaluation work. Registered professional M.E. Age 32; married. Position desired with aircraft manufacturer or allied industry.

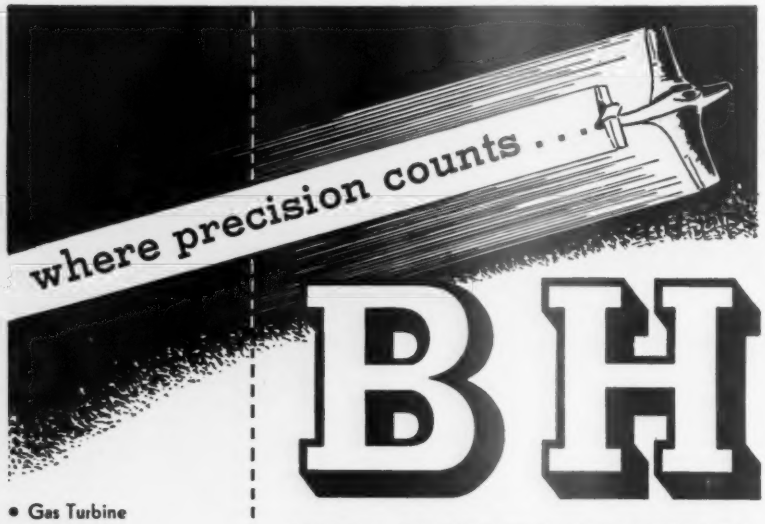
981. Design or Development Project Engineer—Fourteen years specialized in aircraft power-plant design, installation, test, research and proposal work as design engineer, group engineer, and senior project engineer. Five years' air-frame design experience and 5 years' diversified tool and plant engineering and shop work. For 2 years, partner of a small midwestern engineering company in charge of design and performance calculations of exhaust ejector pumps and thrust augmentors and some ram-jet engine design work on subcontracts. Last 2 years as design engineer with aircraft gas turbine division of larger corporation in Great Lakes area. Graduated and registered professional mechanical engineer. Well-versed in engineering aero- and thermodynamic and structural analyses, in organizing and handling of projects, in dealing with personnel and cost estimates. Born, educated, and 4 years' engine design experience in Germany. In United States since 1929; citizen since 1934; age 47; married. Desires position as executive or project or staff engineer for production, design, research, or field work on aircraft projects or components, preferably with smaller but aggressive company. Location secondary. Available 45 days after acceptance.

980. Physicist or Research Engineer—B. Aero. E.; 1943 from New York University. Desired location, Northeastern United States. No research experience. Three and one-half years' experience in aeronautical weight engineering. One summer as inspector of small parts for aircraft engines and submarines. Desires permanent position with opportunities for advancement.

979. Industrial Engineer—B.S. Ae.E.; Graduate level work in Theoretical and Applied Mechanics and M.S. in Management. Familiar with accounting and cost control techniques. One year teaching Industrial Management. Former Army Pilot and Aircraft Maintenance Engineering Officer. Desires position suitable for both backgrounds and offering opportunity for variety of experiences. Location open.

978. Aeronautical Engineer—Young man desires to work in research. Degree of Bachelor of Aeronautical Engineering from Rensselaer Polytechnic Institute, January, 1949. A summer's experience in aeronautical research.

977. Management, Engineering, or Administration—Age 47. B.S. in M.E. Over 20 years' good experience in aircraft research, design, production, costs, inspection, and flight performance. Presently head of group testing jet engines and components and designing test facilities. Broad management and administrative experience representing BuAer in major aircraft plants for 5 years. Thoroughly trained in dealing with governmental agencies. Supervision of large groups for past



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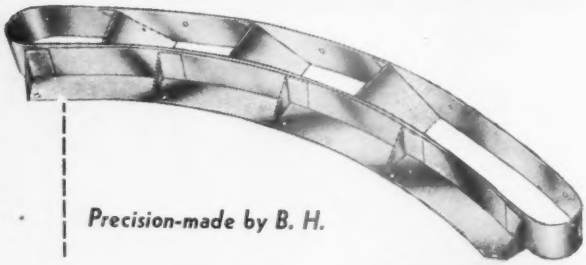

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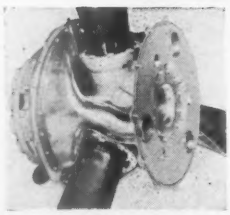

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976. Lead Structural Engineer—B.S. in M.E., Ae.E. Four years' experience in structural analysis, design, and testing. This includes 3 years with the structural design and testing of fighter, cargo, and personal types of aircraft; 1 year of structural testing with the U.S.A.F. Complete knowledge of structural analysis and methods of static testing. Present position, lead structural engineer with four assistants.

975. Aeronautical Engineer—Age 26; Married. Graduate, Academy of Aeronautics in Aeronautical Engineering and Design and Construction. Two years' experience in Aviation Industry as designer, draftsman. Speaks, reads, and writes Spanish, French, and English. Location open.

973. Aeronautical Engineer—B.S. Ae.E.; 3½ years' experience in aerodynamics and development engineering. Past 2 years as research aerodynamicist and project engineer in transonic wind-tunnel testing laboratory. Desires broader experience in research and development work of advanced aircraft design.

Books

(*Continued from page 67*)

The author's aim is to aid the undergraduate student in the art of translating theoretical analysis into the concrete numerical results usually required in practical applications. This book is designed to provide elementary instruction in the solution of equations, interpolation, numerical integration, numerical solution of differential equations, finite differences, approximations by least squares, smoothing of data, and simple equations in finite differences. Some knowledge of calculus and differential equations is required of the reader. The author is Professor of Mathematics at Oregon State College.

Introduction to Topology. Solomon Lefschetz. Princeton, N.J., Princeton University Press, 1949. 218 pp., diagrs. $4.00.

Designed as an introduction to the topology of polyhedra, suitable for graduate students of mathematics, this book opens with a preliminary survey and a chapter of basic information about sets, spaces, vectors, and groups. Chapter 2, Two-dimensional Polyhedral Topology, includes a number of basic concepts and serves as an introduction to the main part of the book. The Theory of Complexes, Transformation of Complexes, Simplicial Approximations, Further Properties of Homotopy, Fixed Points, The Fundamental Group, The Homotopy Groups, Manifolds and Duality Theorems are among topics discussed. The author is the Henry Burchard Fine Research Professor of Mathematics at Princeton University.

Aeronautical Reviews

(*Continued from page 62*)

tions to wing-body data, particularly when the ratio of body diameter to wing span becomes large.

Some Notes on the Performance of Small High Speed Wind Tunnels. G. M. Lilley. *College of Aeronautics, Cranfield, England, Report No. 23*, December, 1948. 23 pp., diagrs., figs. 3 references. Layouts and performances of various types of tunnels that use less than 100 b.hp. with working sections of 2 in. by 2 in., which might be suitable for college and universities.

Wind Tunnels With Energy Accumulation. Otto Frenzi. *Interavia*, Vol. 4, No. 1, January, 1949, pp. 35–38, illus., diagrs., figs.

Replacement of the continuous-function, blower-driven types of wind tunnels with designs that are characterized by an energy accumulation and air intermittent function. Earlier type tunnels of this included a supersonic wind tunnel in Russia which used a group of compressed air bottles as an accumulator. Another in Germany and one in France used a container that had been pumped free of air and which then sucked air through the test section. Another, driven by an ejector fed by air from a compressed-air container, gave inefficient service while used in the U.S. and in Britain. A steam-jet-driven high-velocity wind tunnel was erected at the Junkers Works at Dessau. Inexpensive parts were utilized, including two old locomotive boilers used as an accumulator that was charged by passing steam through the water. In operation, ejector action of the steam sucked the outer air through a test section of about 900 sq. cm. and allowed a functioning time of several minutes. This tunnel enabled fundamental research to be carried out on the aerodynamics of the J-287 jet-propelled bomber. A development of the Junkers installation is the transsonic wind tunnel now being built near Paris by the SNECMA concern.

Drive for Hugh Supersonic Tunnel. *Aviation Week*, Vol. 50, No. 4, January 24, 1949, p. 20, illus. Three 29,000-hp. electric motors are hooked in tandem to turn a seven-stage compressor in the N.A.C.A. Lewis Flight Propulsion Laboratory, Cleveland.

I.A.S. National Meeting Schedule

Annual Summer Meeting—Los Angeles—July 21–22

Thirteenth Wright Brothers Lecture—Washington, D.C.—December 17

Eighteenth Annual Meeting—New York—January 23–26, 1950

Members or organizations wishing to submit papers for presentation at National Meetings should send outlines or summaries to the Committee at least 3 months prior to the meeting.

All papers submitted will be considered for publication in the *Journal of the Aeronautical Sciences* or the *Aeronautical Engineering Review*.

All correspondence should be addressed to
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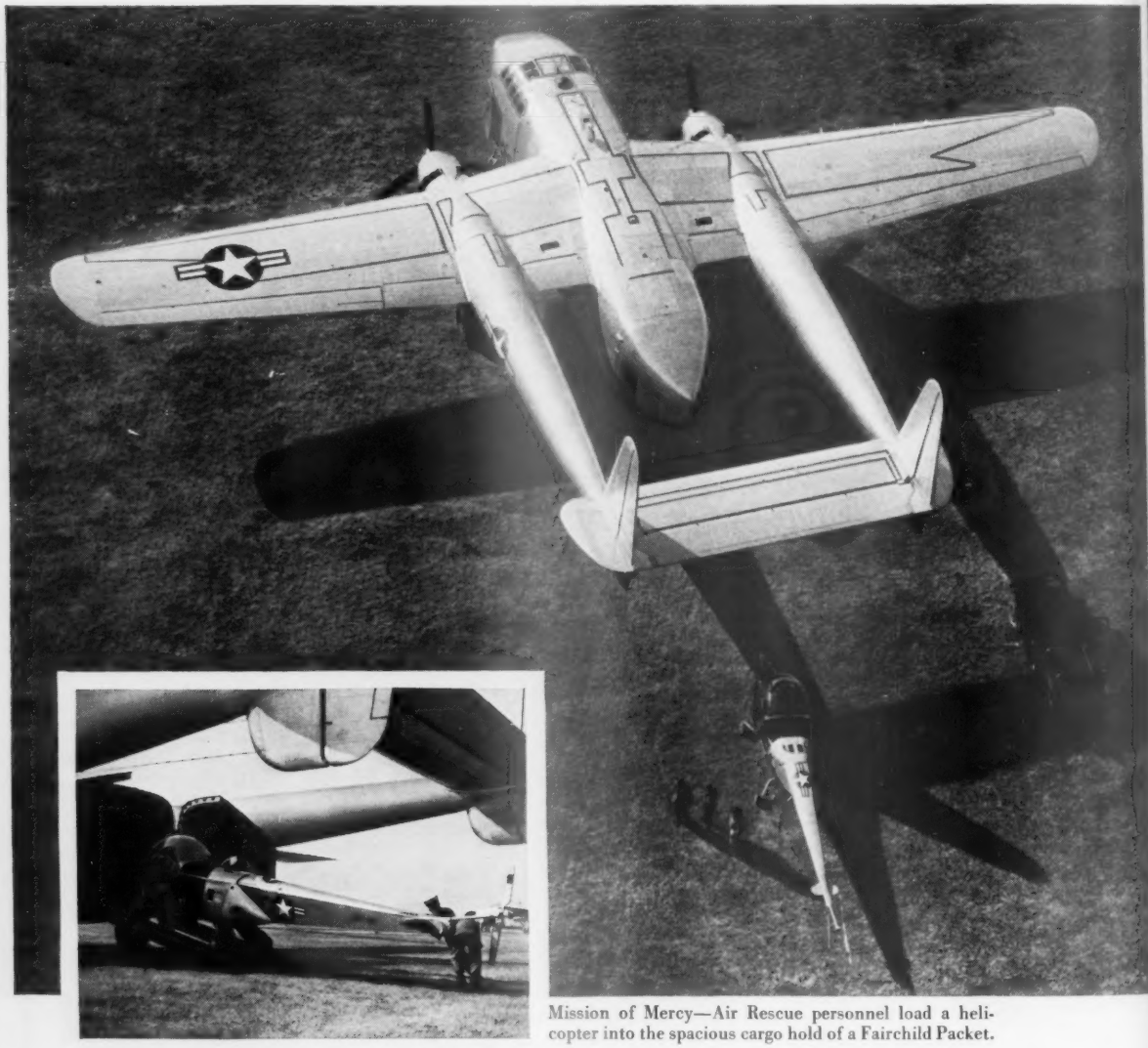

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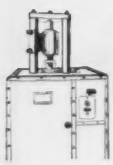

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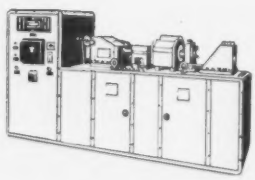

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